EDITORIAL

MARE ISLAND NAVY YARD according to a statement recently issued by the Navy Department shows the lowest overhead costs of any yard in the country. The record also shows the Mare Island yard as second in number of employees, the approximate figures for the three leading yards being New York, 12,000. Mare Island, 9000; and Philadelphia, 8500.

A RECENT statement issued by a prominent brokerage house says: "In order to have a broad market the public must be in. Being active in both upward and downward trends they furnish a real market." All very interesting, but the rugged pioneers of the John Oakhurst class had a simpler way of phrasing it. "Outside money builds up the camp," was their method of expressing the same thought.

OUR attention has been called to two inaccurate statements in the article on electric furnaces in the State of Washington appearing in our June issue. It was stated therein that the Greaves-Etchells furnace at the Bremerton Navy Yard is a two-electrode furnace, while as a matter of fact, it has four. Two phases of the three-phase primary supply are connected to two pairs of top-electrodes, and the whole of the furnace acts as the third electrode. It is further stated that the three-ton Girod furnace at the Washington Iron Works is the only one in the State where refining is done, whereas the Bremerton furnace has a basic lining and is refining every heat.

STEEL ships for private account in the United States on June 1, according to a statement prepared by the Bureau of Foreign and Domestic Commerce, including those under contract as well as those on the ways, amounted to 345 with a tonnage of 1,360,643. Pacific Coast yards are well represented in this total. Yards in the San Francisco Bay district have 24 vessels with a tonnage of 151,002. Those in the Los Angeles district have 4 vessels with a tonnage of 2665. In the Columbia River district there are 13 vessels under contract with a total tonnage of 102,182. In the Puget Sound district there are 3 vessels with a total tonnage of 10,038. These figures are exclusive of Shipping Board contracts or of Navy Yard operations.

REAL conservation is a fine thing, but the substitute that has been handed to us for the past ten or twelve years by certain erratic enthusiasts is something entirely different. Fearful lest somebody should 'slip something over', they succeeded in either locking up entirely the natural resources in Government control, as in the case of oil, coal, and phosphates, or else hedged the development about with so many restrictions, as in the case of water-power, that no one would accept these restrictions if he could develop power in any other way. Happily, the era of pseudo-conservation seems to be nearly over. While the provisions for leasing oil, coal, and phosphate lands in the bill passed at the last session of Congress are not liberal, still they are a step in the right direction. Now the water-power bill has also become a law, although there was considerable uncertainty for a while as to whether or not it had been lost in the shuffle. Restrictions on power development involving use of land in the National forests, which means practically every important project in the West, have been lightened to the extent of making such development commercially practicable. The metal trades have a double interest in hydro-electric development; first, as the sources of supply of the machinery and equipment for projects; and second, as consumers of power. Anything that helps the power companies is going to help the metal industries of the Pacific Coast as well.

'FEDERATED AMERICAN ENGINEERING SOCIETIES' is the name of the organization that will be formed as the result of a conference of representatives of 57 national, state, regional, and local engineering and technical societies held at Washington on June 3. Resolutions were adopted calling for the formation of an organization to further the public welfare where technical knowledge and allied experience are of value and to consider and act upon matters of common concern to the engineering and allied professions, such an organization to be one of societies and not of individuals. Delegates from the American Association of Engineers opposed the resolution during discussion but voted for it when the prevailing sentiment was seen to be strongly favorable. A constitution was prepared and will be submitted to the members of the various societies represented, delegates from 49 societies voting in the affirmative, the remainder being undecided. The constitution provides for a governing council to which the member societies shall elect representatives according to their total number of members, for the support of the federated organization by the member societies, and for the formation of State councils on somewhat the same general plan as the proposed National body. In general, the proposed organization is to bear the same relation to the present engineering societies and to the individual engineer as the Chamber of Commerce of the United States does to the local chambers and to the individual business man. There is need for such an organization, and we hope that this need can be satisfied.

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Threads Commission Reports

The National Screw Threads Commission appointed by Congress in July 1918 has rendered its report, but will continue in existence for two years more in order to pass upon questions of adjustment or modification of the proposed standards. The Commission is composed of two representatives of the Army, two of the Navy, and four civilians nominated by the National engineering societies, together with Dr. S. W. Stratton, director of the Bureau of Standards, who acts as chairman. In general the report endorses existing standards in common use. The coarse-thread series recommended is the present United States Standard, supplemented in the sizes below ¼ inch by the standard established by the American Society of Mechanical Engineers. The fine-thread series follows the Society of Automotive Engineers standards. The Briggs Standard is recommended for pipe-threads, and the standards developed by the National Fire Protection Association and the Bureau of Standards for fire-hose threads. The most important and exhaustive work of the Commission has been regarding tolerances and gauging. The Commission has even gone so far as to recommend different limits for screw-threads for different classes of machinery, the smaller tolerances to be used on the lighter and more delicate machines. A fair trial of these tolerances should be made by manufacturers, as this is the only way to obtain the maximum benefit from the work of the Committee.

Strike Flickering Out

The decision of the shipyard carpenters and joiners to return to work, as recorded in our issue of a month ago, proved to be the beginning of the end of the strike that has affected shipyards and shops in the San Francisco Bay district during the past nine months. The more important among the unions affected have voted to return to work under on agreement the salient clauses of which are as follows: The scale in effect on September 30 last stands until an adjustment is announced by the conference regarding shipyard wages throughout the country now in session at Washington. All former employees making application for work within 30 days from the adoption of the agreement shall be re-employed as rapidly as conditions permit. Grievances under this re-employment provision are to be referred to a committee composed of representatives of both sides. The unions have announced the intention of retaining their organizations, but the open shop prevails with each employer dealing with his own men under the so-called American plan. Meanwhile, the members of the California Foundrymen's Association, which includes most of the foundries of the district, are operating under the union agreement negotiated last December, and a number of the smaller shops in all lines are operating under individual agreements signed with the unions at various times since the beginning of the strike. The statement made in these columns several months ago still holds good. The metal-trades employers have settled nothing as yet, they have merely started something. The first skirmish in the fight to establish the open shop has been won, but no man enjoys defeat and the union men now returning to work, together with the former union men that went to work before the conclusion of the strike, cannot be expected to enjoy theirs. The struggle will be reopened at the earliest favorable opportunity. Only by standing together on the one hand and by fair dealing with the individual employee on the other can the members of the California Metal Trades Association prevent the return of the closed shop.

The Democratic Convention

This is written during the heat of Convention Week, a heat that is, fortunately, political, and not climatic. What candidate will be nominated, whether the platform will be dry, wet, or merely damp, whether the declaration for ratification of the Treaty will be 'with or without', whether the labor planks will incline toward the views of Mr. Gompers or of Judge Gary, all this and much more is uncertain. We will not even risk our reputation by hazarding a guess regarding an outcome that will be known to all our readers by the time they read this paragraph. It is rather of other aspects of a National political convention that we would speak. Such a convention is after all 'the greatest show on earth'. It is true that, unlike most other circuses, what occurs in the side-shows is the most interesting, and that, still widely-different from other circuses, few of those with tickets to the Big Tent are able to gain admission to the side-shows. But even the man that is not admitted to either the committee-rooms or the main hall, can learn a great deal simply by being in the same town when a convention is being held. Most men read about those who are active in the government of the Nation, but seldom see any of them. This fact makes it easy to fall into the habit of considering the Government as a thing apart, to say 'they' instead of 'we' in speaking of its activities. The best cure for this habit that we know is to see some of these men whose names appear on the front page so often. Not because they are so great, but rather because they are not, being most of them very much like the rest of us. It is a good idea to study even the rank and file of the delegates, the men whose names are seldom, if ever, mentioned outside of their home-town paper. That crowd of middle-aged, straw-hatted, guadily-badged men is not trying to 'put something over' on the rest of us. Of course, they want to win, but they would all prefer to win by fair means, and most of them, we believe, would prefer to lose rather than win by foul. They may, and probably will, not make the wisest choice, either in candidate or platform, but they will probably do as well as they can. Wherefore, we hold that it is a good idea to hold conventions in as many different cities as possible, both for the sake of the delegates and for the sake of the residents. It was Charles Lamb that said "I can't hate anybody I know", and a convention is one way of getting people to know each other.

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Conseratives Still in Control

A study of the program adopted by the American Federation of Labor at the Montreal convention indicates that, while 'boring from within' may have made some progress, the conservatives were still sufficiently in control to dictate most of the Federation's platform. Even the plank calling for government ownership of the railroads, which was strongly opposed by Mr. Gompers together with nearly one-fourth of the delegates, can hardly be called ultra-radical. While it calls for 'democratic operation' of the roads, whatever that may be, the Plumb plan is not specifically mentioned. Mr. Gompers was right, we believe, in holding that government ownership would be even more inimical to the special interests of the wage-earner than to the general interests of the public, but there are many conservative people holding the opposite view. With the exception of the, we suspect, perfunctory endorsement of the Irish republic, the various political measures advocated might have appeared in the platform of any party. Of the industrial planks, the right of collective bargaining is no longer an issue, although the interpretation of that right is still a matter of dispute. Advance of wages where required to maintain standard of living and a shorter working-day where required to prevent unemployment would both probably be matters of general agreement in the abstract and general disagreement in the concrete. The only plank in the labor platform that is conspicuously radical or conspicuously reactionary, according to the point of view, is that upholding the right to strike and calling for the abolition of compulsory arbitration and of anti-strike legislation. Space will not permit a discussion of these questions, but we will indicate the grounds for our belief that the Federation may some time come to a different opinion than the one it now proclaims. For years the right of picketing and the right of boycott were vehemently asserted by the Federation. The Montreal platform is silent regarding either of these so-called rights. The Federation is thus a progressive as well as a conservative body. Let us hope that it will progress far enough to abandon several of the beliefs that it now holds.

Present Status of Concrete Ships

Since the Armistice, the public has paid little attention to the concrete-ship program of the United States Shipping Board, but, nevertheless, all sorts of rumors have been current regarding the ships under construction. Among other things, they have been reported as sunk, leaking, breaking to pieces, and dissolving. They are doing none of these things.

Operations at the yard on Government island in the Oakland estuary, which was described in 'Metal Trades' for April 1919, may be taken as typical of all the concrete-ship work done by the Board, except perhaps that the Oakland yard has done more experimental work than the others. The original plans called for the construction of two 7500 ton deadweight tank-steamers and one 7500-ton deadweight freighter. One tank-steamer, the 'Palo Alto', has been launched, but is not yet completed. The other, the 'Peralta', is nearly ready for launching. The freighter was partly completed when orders were received to abandon and dismantle her, which has been done. The yard was shut-down entirely for five months on account of a strike, and operations now are hampered by the labor shortage, which is affecting all industries, but which is particularly troublesome there because the Macy scale is being paid, which is lower for most classes of work than the ruling wage now being paid in this locality.

The design of the vessels has been altered considerably from the plans originally prepared, principally in providing additional interior bracing. Part of this additional bracing has been needed merely in order to obtain a rating for the vessels, and part of it has been required because the original design was inadequate for actual service conditions. This additional bracing has been placed by breaking into the concrete, setting the reinforcing rods in their proper places, and placing new concrete. What is particularly interesting, and what may easily prove to be of considerable importance in other reinforced concrete work as well as ship construction, is the fact that while openings have been made in the hulls at hundreds of places for setting the additional bracing, no appreciable leakage has developed in the new concrete. In fact, although the 'Palo Alto' has been in the water for several months, the hull has remained substantially water-tight. This is particularly important in view of the fact that a very light concrete was used.

Using this light concrete, the concrete hull for a 7500-ton tank-steamer will weigh about 5000 tons, 1500 tons of steel and 3500 tons of concrete. The hull of a steel ship of the same capacity would weigh about 3500 tons. The engines, machinery, and other items of light displacement would weigh practically the same for either vessel, about 1000 tons. In fact the mechanical equipment for either vessel is practically the same. This makes the total light displacement for a steel tank-steamer of that size 4500 tons, and the light displacement of a concrete vessel 6000 tons, which shows the large advantage in operating costs for the steel vessel, as far as tankers are concerned. The cubic capacity of a 7500-ton concrete tanker is about the same as that of a 10,000-ton steel tanker, and the two vessels are about of the same dimensiosn, so that for certain kinds of light bulk-cargo, the concrete ship would stand on an even footing with the steel ship. Here is what appears to be the best field for the concrete ship to develop and very likely to make good, namely, in handling light bulk-cargo on runs of such a character that this kind of cargo can always be obtained.

For heavy cargo, the concrete ship cannot compete with the steel one at the present time, nor does it seem likely that it ever can. From an economical standpoint, a tank-steamer in particular is the worst possible type to

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build of concrete, although such a steamer can be constructed to give excellent service.

The concrete ship work for the Shipping Board has been largely experimental, and, therefore, has been slow and expensive, but it is far from being barren of result. The field of the concrete ship is limited, and is likely always to remain so, but its field does exist.

The Part-Time Education Act

July 1, 1920, is likely to go down on the records as one of the most important dates in the industrial history of the State of California. No. Guess again. It is not because it is just a year since the country went dry, although that did make a lot of difference. It is because the Part-Time Education Act goes into effect at that time.

In another column we publish a summary of some of the most important features of the Act, as far as they affect the metal trades, but we would strongly advise anyone whose business may be influenced by the workings of the Act, and who has not already done so, to obtain from the California State Board of Education at Sacramento, Bulletin No. 23, P.-T.E, which gives not only the text of the Act, but also a discussion of its provisions prepared by Mr. Edwin R. Snyder, former commissioner of vocational education, and his associates. Every employer should do this, if for no other reason, than because if he fails to acquaint himself and to comply with its provisions, he is likely to wake up some day with a jail sentence staring him in the face.

A far more important reason, however, is the fact that this Act marks another step in the movement toward trained workmen and workwomen to our industries, and, better yet, toward making the schools furnish a real training for life. Every institution, no matter how good, has a tendency to lag behind the progress and the needs of the world, and the school has been no exception to the general rule. Whatever the exact derivation of the word may be, we claim that to educate is to make men and women, trained for efficient work as well as for the other activities of life. That the school has failed to do this in the past is particularly true for the trades and industries. In the old days, when the apprenticeship system was really effective, and life was simpler in a good many ways, this did not matter very much. But the apprenticeship system broke down some time ago, although most of us failed to realize it until the War cut off the supply of workmen trained in 'the old country'.

Even before the War, far-sighted employers had realized the futility of expecting to reach out into thin air and obtain an abundant supply of trained workmen. The various 'company schools' were the result of this realization. However, private enterprise is not, probably never will be, and should not be expected to be, equal to the task of providing vocational training for those who need it. Neither is it likely ever to be true that all such boys and girls will be able to afford to take a full-time course at a vocational high-school. It is for these others, who must go to work as early as the law allows, that the Part-Time Education Act has been passed. These are the boys and girls, who, lacking in training, usually drift from one unskilled poorly-paid occupation to another, 'blind-alley jobs' for the most, and who furnish willing hearers to the agitator. The fundamental idea of the Act is the provision of education during the usual working-hours of the employed. For, great as have been the accomplishments of the evening school, it is far from being entirely satisfactory. The exceptional boy or man, who has the physical strength to perform mental labor after a hard day in the shop and who has the moral stamina to be willing to do so, can be benefited by the evening school, but the average worker, in order to profit by instruction, must come to it fresh in body and mind.

The Part-Time Education Act then offers a great opportunity to the working boy and girl, in providing training toward a better job and a broader life; to the employer in helping to train an efficient body of workers; to the State as a whole, in training a large body of efficient clear-thinking citizens. These are great results, but they will not come to pass without co-operation by all concerned.

They will not come to pass if employers connive at or tactly encourage perjury on the part of minors subject to the Act and their parents or guardians. These may seem to be harsh words, but they are warranted by the facts. In one Californian community, of a size that would indicate about 150 boys and girls coming under the Act, less than 30 could be found as a result of a preliminary survey by the State authorities.

They will not come to pass if employers and the public in general pay as little attention in the future to school-board matters as they have in the past. The school authorities and the teachers mean well, but few of them know what is needed to train workers for industry. They will need all the help and advice they can get. On every high-school board maintaining part-time classes in the State there ought to be at least one man engaged in the active management of an industrial enterprise, and he should have the support and advice of the other business men of the community.

Another department in which the employers can render important assistance is that of vocational counsel. The bulletin already mentioned suggests that the vocational counselor should preferably be the principal or vice-principal of the local high-school. It seems to us that a man of wide industrial experience would be far better. Scattered through the State there are many men with years of experience in the management of industries, but who have now retired from active business. Such men would make admirable vocational counselors. There are others whose business engagements would limit the time they could devote to such work, but who could well advise the counselor, were he school official or of the type already described.

In short the proper administration of the Part-Time Education Act is going to require the expenditure of both time and money, but it will be worth while if we do it right.

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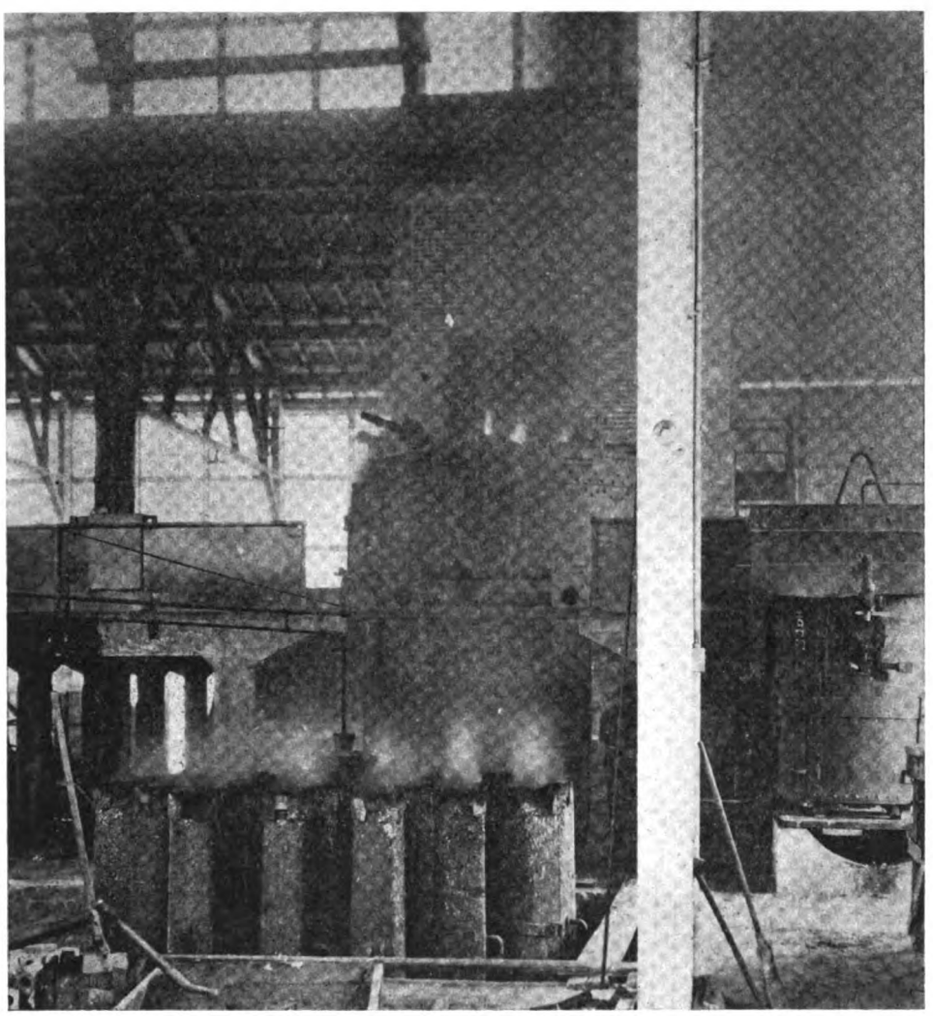
Electric Steel-Making at the Sacramento Shops of the Southern Pacific Company

The general industrial expansion of the Pacific Coast, especially in the metal trades, is exemplified not only in the ordinary commercial shops and factories but also in the railroad shops. In particular, in spite of the fact that general conditions have not been favorable to increased railroad activities, the Southern Pacific shops at Sacramento have expanded considerably during the past year or so. A shop devoted to the fabrication of frogs and other track specials was finished last year, a steel-foundry has just been completed, and work is now under way on a new brass-foundry and a new spring-shop.

Of these new buildings, the steel-foundry is probably the most important, for the others mean simply improved facilities for work that was or is already being done at the shops, while steel ingots and castings have, up to the present time, been bought by the company. The steel-foundry is a modern heavy-wood frame and corrugated-iron building 128 by 128 ft., comprising a main bay 64 by 128 ft. and two side bays each 32 by 128 ft. The building is well lighted and ventilated, and there is abundant head-room for operating the 15-ton Champion traveling crane, which runs in the main bay. Steel is melted in a 6-ton Heroult electric furnace, equipped with General Electric Co. control. Power is obtained from the Pacific Gas & Electric Co., the voltage being stepped down to 110 by the transformer directly back of the furnace. After the current is first turned on, the amount is brought up gradually to 7000 amperes per electrode, and is held at that figure until the charge becomes fluid, when it is reduced to 5000 until the first slag has been removed. During the refining period following the addition of the second slag the current is increased to 6000 amperes.



JUST BEFORE POURING FROM THE FURNACE. THE FLAMES COMING FROM THE INGOT-MOLDS ARE FROM THE OIL-BURNER USED TO DRY THE MOLDS. AT THE RIGHT IS THE LADLE, READY TO BE SWUNG INTO POSITION IN FRONT OF THE FURNACE.

At the present time, the output of the foundry is confined to ingots for the company's rolling-mill. One shift is being worked, but this will probably be increased to two before long. As a rule, two heats are poured per shift. In order to do this, three men start work about five, charging the furnace and turning on the current. The remainder of the force comes to work at seven, and the first heat is poured between nine and ten, the second about two, and the remainder of the shift is devoted to cleaning up, patching the furnace lining, and generally getting ready for the next day's work. The succession of operations for a complete heat is approximately as follows:

Charging, 20 to 30 minutes.

Melting down, 3 hours.

Removing first slag, making additions, and adding second slag, 15 to 20 minutes.

Refining under second slag, 25 to 30 minutes.

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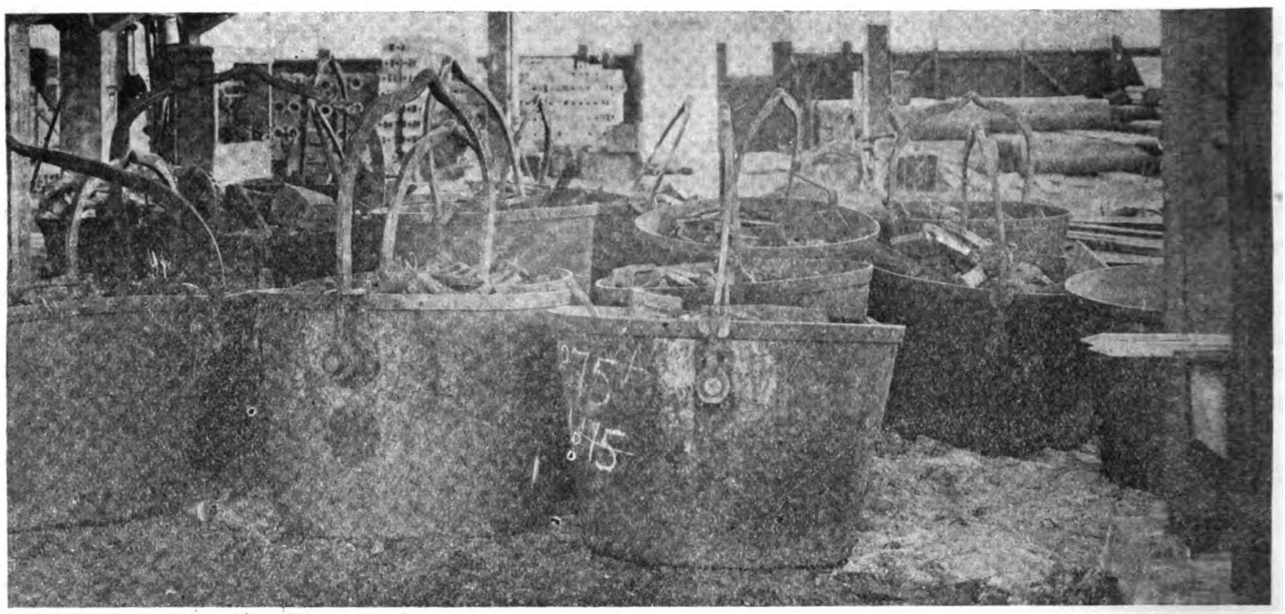
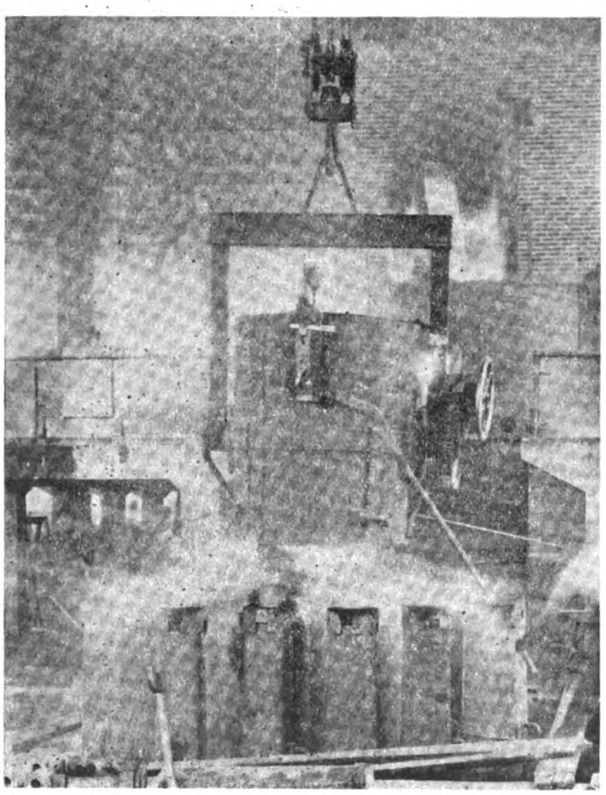


SCRAP AS DELIVERED READY FOR CHARGING THE FURNACE

Patching lining, 15 minutes.

The furnace is basic-lined. Cold scrap is used exclusively for the charge, practically all the scrap used coming from the company operations, including runners from the steel-foundry work, crop-ends and other rolling-mill and forge scrap, borings and turnings from the machine-shop, and miscellaneous railroad scrap. Except in a general way, no attempt is made to adjust the kind of scrap charged to the kind of steel required, it being simpler to make the additions in the furnace necessary to give the desired result. The scrap is delivered to the foundry, together with other supplies required, on a standard-gauge track running into the main bay, the same switching-engine that delivers the supplies carrying away another car loaded with the ingots cast the previous day.



POURING THE INGOT-MOLDS

Up to the present time, plain carbon steels only have been cast, of three grades, namely, 0.15%, 0.25%, and 0.50% carbon. The manganese and silicon contents are as specified. The railroad specifications call for not more than 0.05% of either sulphur or phosphorus, but the steel produced is of considerably better quality, running about 0.02% sulphur and from 0.015 to 0.03% phosphorus.

The furnace is provided with charging-doors on each side, and the scrap is charged by hand or by shoveling according to the size and shape of the pieces. The flux for the first slag is added at the same time. This consists of about 40 lb. of lime per ton of charge together with enough fluorspar to make it run easily from the furnace. When the charge is melted and has become completely fluid, a sample is taken and a small test-bar poured. This is broken, the fracture observed, and a sample taken by boring and sent to the laboratory for a rapid analysis. In about 15 minutes the report from the laboratory is received. The first slag, which is a heavy black de-phosphorizing flux, is then poured off and the proper additions made to give the desired proportions of carbon, manganese, and silicon in the finished product. The carbon is added in the form of old electrodes, the manganese as ferro-manganese, and the silicon as ferro-silicon. After about five minutes, the second slag, which also contains 40 lb. of lime per ton of charge together with enough fluorspar to thin it moderately is added. Test-bars are taken throughout the progress of the heat. The fracture test shows the soundness and temperature of the metal. The second slag is a heavy white de-sul-

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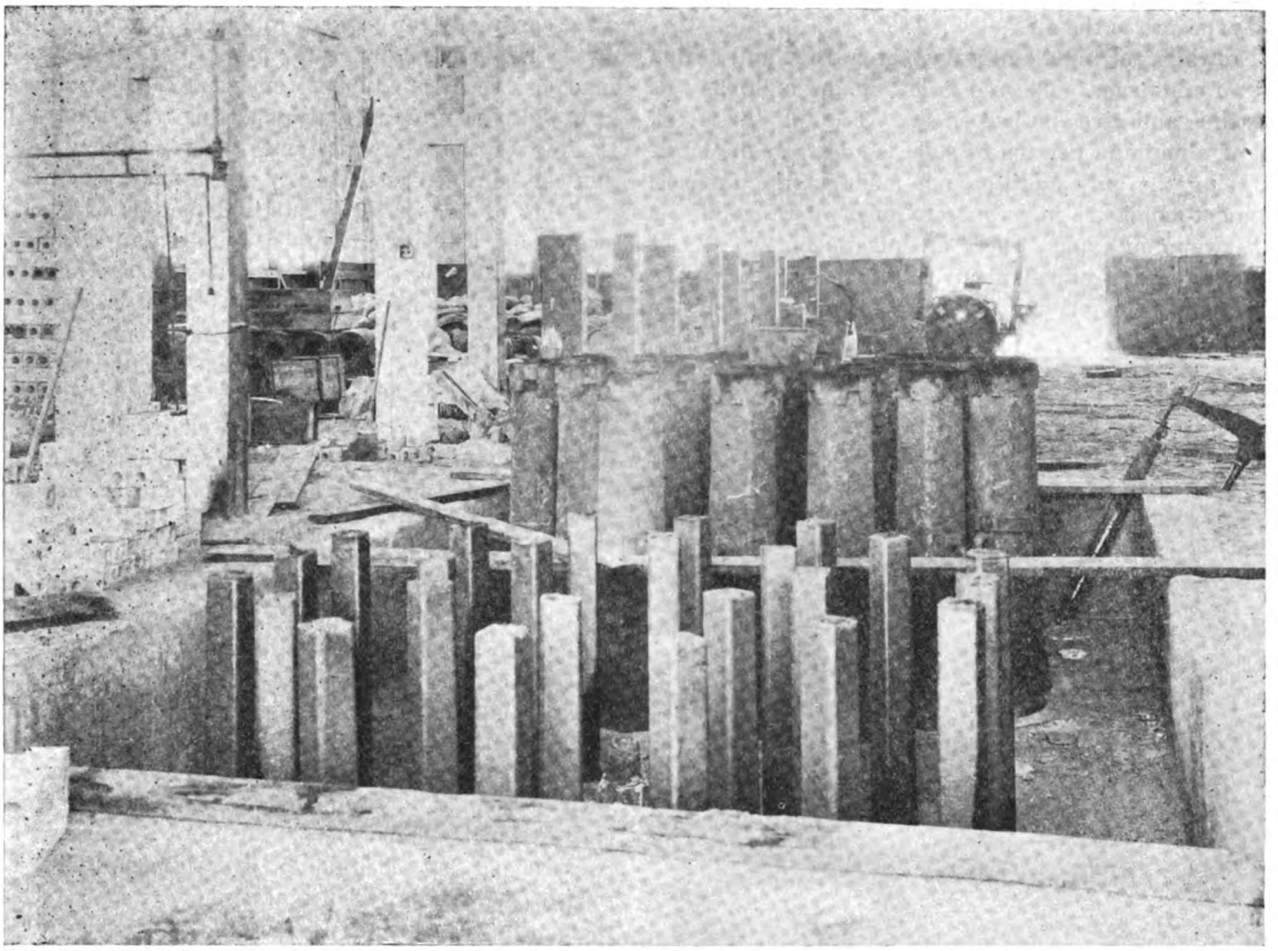
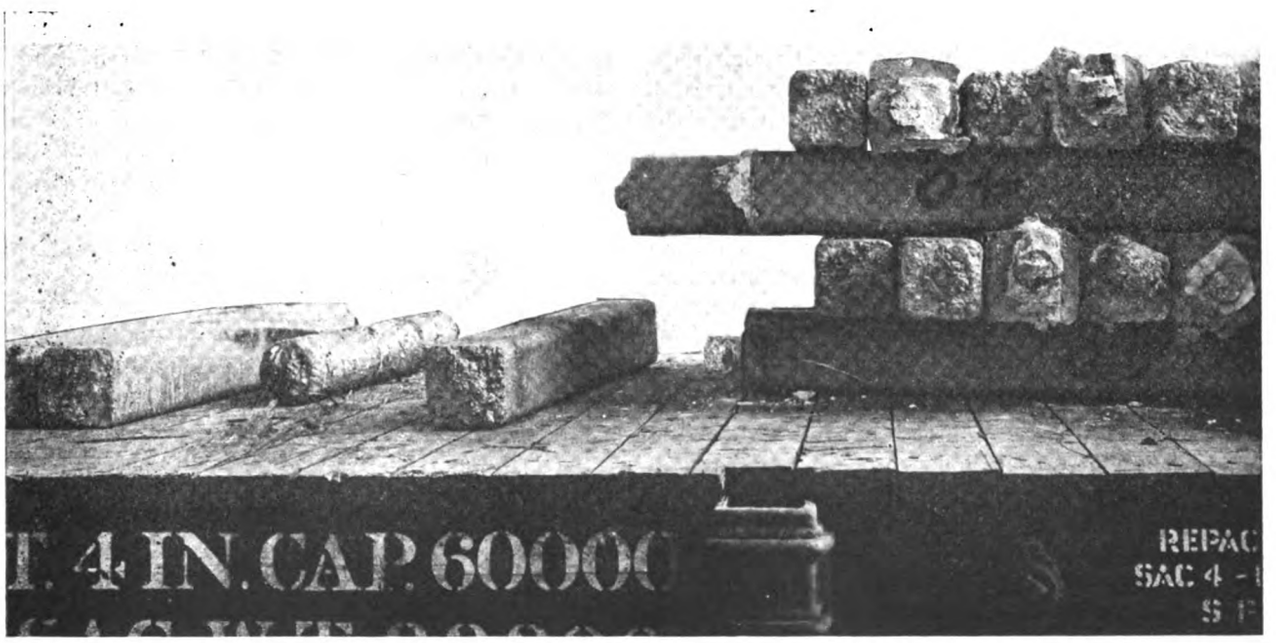


INGOTS JUST AFTER STRIPPING. IN THIS PARTICULAR CASE, THE CENTRAL RISER BROKE WITHIN THE MOLD, WHICH IS UNUSUAL. THE MOLDS HAVE ALL BEEN PLACED FOR ANOTHER HEAT. ON THE LEFT ARE ELECTRODES, REFRACTORY BRICK, AND OTHER SUPPLIES.



PART OF ONE HEAT FROM THE FURNACE. NOTE PARTICULARLY THE ROUND INGOT CUT FROM THE CENTRAL RISER.

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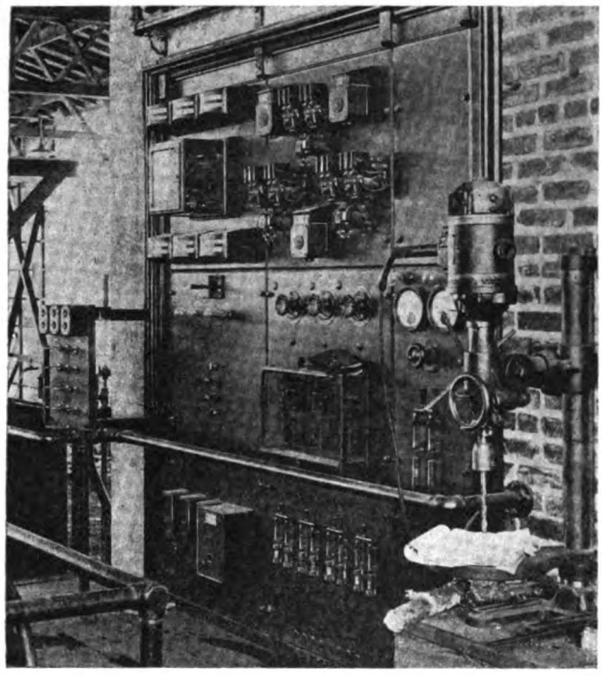
phurizing flux, high in carbon and turning to powder upon exposure to the air.

Meanwhile, the ingot-molds have been dried and heated with an oil-burner. The rod is left in the ladle, as this saves time and gives no bad effects. To 'kill' the metal, ⅔ lb. of aluminum per ton of steel is added in the ladle, this being the only addition not made in the furnace. The ingot-molds are in a concrete-lined pit resembling a small swimming-tank. There are places for two sets of 24 molds each grouped about a central runner. The molds for both ingots and the central runner are of cast-



SWITCHBOARD AND CONTROLS AT THE REAR OF THE FURNACE. ON THE RIGHT IS THE DRILL FOR TAKING BORINGS FROM THE TEST-BARS

iron and were cast in the company's iron-foundry. A few molds cast from iron with a relatively high phosphorus content have had to be scrapped after only 30 or 40 heats, but most of them give promise of lasting for a long time. The ingots commonly cast are 6 by 6 in. section and weigh 500 to 600 lb. Occasionally large forging-ingots 10 by 18 in. are cast.

The metal is poured from the bottom of the ladle. About 20 to 30 minutes after pouring has been completed, the work of removing molds is commenced. At this time the ingots are still red-hot. After six or eight ingots are stripped it is usually time to strip the central runner to prevent its sticking to the mold. The exact time to do this is a matter of judgment, and is gauged by the color of the stripped ingots. As each mold is stripped from the ingot, it is carried by the crane and placed in position in the second group of molds, ready for pouring the next heat. As soon as the ingots have all been stripped, the work of pulling them out of the pit, together with their connecting runners, commences. About three ingots can be pulled at a time. They are carried to a place on the floor near the railroad track. When cool, the runners are cut or broken off and the ingots piled on a flat-car, ready for delivery to the rolling-mill. 'Piping' of the ingots is small, and the pipe is not cut off until the ingot has been rolled down somewhat in the rolling-mill. It has also been found that by cutting a foot or two from the top of the central runner the remainder is sound and can be rolled just like any other ingot, thus effecting a saving of two or three hundred pounds of steel with every heat, which would otherwise be scrapped.

Besides the superintendent, who also acts as melter, 13 men are required on each shift when, as is now the rule, ingots only are poured. Of these, one man will be working on general cleaning up and similar work, and the remaining twelve on the pits, ladles, and furnace-platform. Four of these may be considered as skilled, two on the furnace, one ladleman, and one man on the pits. The present force is somewhat larger, but this is because of the need of training enough men for two shifts before starting the second shift. It might also be mentioned that the term 'skilled' has a general significance only, as with the exception of the superintendent, none of the men had had any steel-foundry experience. They were selected from the shops in general, the main idea being to obtain young, intelligent, and active men, who would respond to training. That this policy has been successful may be judged from the following facts:

Operations at the foundry were commenced about the end of April. During May, 35 heats were poured, the two-heat-per-day schedule not prevailing until the latter part of the month. The total cost of steel produced for the month was 4¼ cents per pound. This is very gratifying as it includes a general shop-overhead charge of 24% on labor and rather high prices on all material. These figures can be reduced as operations become more nearly continuous. That these low costs have not been obtained by a sacrifice of quality has already been indicated by the figures regarding chemical analysis, and is also shown by the tensile tests, which average 60,000 lb. per square inch and 32% elongation for the 0.15% carbon, 80,000 lb. and 25% elongation for the 0.25% carbon, and 106,000 lb. and 18% elongation for the 0.50% carbon steel.

Acknowledgment should be made to D. S. Watkins, general superintendent of the shops, and L. J. Barton, superintendent of the steel-foundry for their cordial co-operation in the preparation of this article.

SHE had inspected every parrot in the store, and the dealer was getting tired. She declared one bird was too green to go with the dining-room and another too red for the drawing-room, and so on.

At last she almost settled on a purchase. Then suddenly she asked:

"But is he a good bird? I mean, I hope he doesn't use dreadful language."

"E's a saint lady," breathed the dealer fervently. "Sings 'yms beautiful. I 'ad some parrots wot used to swear crool, but, if you'll believe me, this 'ere bird converted the lot of 'em."—Pittsburgh Chronicle-Telegraph.

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The Part-Time Education Act of California*

On July 1, 1920, the part-time education act passed by the California legislature, and found on page 1047 of the Statutes of 1919, goes into effect. Five days after the opening of the fall term of the local high-school for the year 1920-1921, and thereafter, no employer may safely employ a boy or girl between 16 and 17 (after July 1, 1921, between 16 and 18) years of age, unless said youth has filed with him a certificate of enrollment and permit to work bearing the name of the high-school principal of the district wherein the pupil resides, or in lieu thereof, a statement from said high-school principal to the effect that the high-school of that district does not maintain special part-time classes suitable for the needs of such boys and girls. Within five days after said boy or girl has filed his certificate of enrollment and permit to work, said employer must on a blank issued by the high-school authorities and presented by said boy or girl notify the high-school principal issuing the certificate of enrollment and permit to work of such employment. These papers must be retained on file. Should an employer be notified by the high-school that he is employing a boy or girl after already working eight hours during any day, he must forthwith desist from such excess employment. Failure to comply with any of the above provisions is a misdemeanor and renders an employer liable to fine, imprisonment, or both.

Evidently this is a law 'with teeth to it'. Let us examine them more closely. The law deals with two classes of persons as follows:

First: those between 16 and 18 (during the coming year only, between 16 and 17) who have not had a four-year high-school course or its equivalent, who are not now attending either a full-time or a part-time day class, public or private, and who are not exempt as specified below. Such persons cannot be exempted because of evening-school attendance.

Second: Those between the ages of 18 and 21, who cannot speak, read, or write the English language with a degree of proficiency equal to that required for completion of the sixth grade of the elementary school. This article will deal with the first class of persons only.

The following are exempted from compulsory attendance:

1. Those who, because of physical or mental condition, are unable to attend or to benefit by the instruction.
2. Those who must render personal service to dependents, such as their own children or invalids for whom other provision cannot be made.
3. Those who reside more than three miles from a suitable class maintained.
4. Those whose interests would suffer if they were compelled to attend classes. The number exempted under this provision shall not be greater than 3 plus 5% of the total number of persons in the district subject to compulsory attendance upon part-time classes.

Any high-school board may establish part-time classes in connection with any of the day high-schools of its district, and classes must be established in connection with all high-schools where there are as many as 50 full-time day pupils residing within three miles of the school and as many as 12 persons subject to the compulsory attendance under the Part-Time Act.

From the above provisions it will be seen that, while certain small country high-schools and certain country residents in other high-school districts, may be outside the Act, practically all employees in metal-trades shops within the prescribed ages, except those exempted under divisions 1, 2, and 4 above, will come under its provisions.

Classes may be held at any time and any place within the district. High-school authorities shall, as far as possible, maintain classes upon such days, during such hours, and at such places as will be most convenient for attendance by the employed youth of the community. In some instances it will be advisable to maintain classes in manufacturing and commercial institutions, or in other places of employment. Each person subject to the provisions of the Act must attend classes not less than 4 hours per week for the regular school term, or not less than 144 hours per year. The high-school authorities must maintain classes for a sufficient number of weeks per year to make this possible. The law also permits the establishment of short-term full-time courses giving at least 144 hours of instruction. It is hardly likely, however, that this provision will affect pupils employed in the metal trades. While it is recognized that circumstances may compel the establishment of Saturday afternoon classes under the Act, the general rule is stated that it is not expected that attendance upon classes shall be required outside of the usual working-hours.

Funds for the maintenance of part-time classes must be provided by the high-school board. The local boards will receive State and county aid, and, under certain circumstances, Federal aid.

A part-time pupil may work and attend school for not more than eight hours per day. As already noted, the enforcement of this provision is in the hands of the local high-school principal.

The following subjects must be taught in part-time classes.

1. Citizenship must be taught to all pupils.
2. Vocational subjects, or subjects supplementing vocations, must be taught to those engaged in skilled occupations who need and desire such instruction.
3. Home economics must be taught to those who need and desire such instruction.
4. Pre-vocational and vocational subjects must be taught to those engaged in unskilled occupations.

*Based mainly upon bulletin No. 23, of the California State Board of Education.

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5. English must be taught to the second class of persons noted above as coming under the Act.

6. Social and vocational counsel and guidance must be provided for all pupils.

Any subject suitable for the needs of the various pupils attending the classes may be taught. Each person, except those deficient in the English language, must take a course in citizenship, and a pre-vocational, a vocational, or a supplemental vocational subject. Each person deficient in the English language must take a course in citizenship and such courses in English as will remove that deficiency.

The following division of the four hours of instruction per week is suggested:

Citizenship, minimum	40 minutes
Pre-vocational, vocational, or supplemental vocational, or for those deficient in English, English, minimum	120 minutes
Other subjects, maximum	80 minutes

The law provides that part-time pupils must be taught in classes separate from full-time pupils. It also provides that no uniform standard of proficiency shall be maintained, except in subjects designed to prepare for other classes or other schools.

Since part-time pupils are highly individual and differ greatly from one another, the individual method of instruction will have to prevail in most cases. However, in large centres, segregation of pupils may be made that will permit a considerable amount of class instruction.

Four hours per week is too short a time for a pupil to receive an education. Therefore, these four hours should be used largely for the organization and direction of the pupils' interests outside of school. To this end, the project† or task method of instruction should prevail. It will be useless, however, for teachers to prescribe outside work for pupils. At the same time, much outside work may be secured if the school instruction follows the interests of the pupils.

As far as possible, the school class-period of the part-time pupil should be a clearing-house for experiences gained outside, whether such experiences be in connection with ordinary instruction, general reading, vocations, or other social contacts.

It is one of the duties of the teacher to discover and to develop any interests that may serve as a basis for the development of the pupil. Some pupils will have many interests, some of which are permanent, others merely transient. Where permanent interests exist, appeal should be made to them. Where no interests exist, it is the duty of the teacher to arouse some that may become a basis for the development of the child.

During the class-period, individual conferences with pupils should provide for the following:

1. The selection of a project.

2. The consideration of methods of procedure in developing or working on the project.

3. The direction of the reading necessary for the intelligent pursuit of the project.

4. The experimentation and demonstration necessary in securing information needed in carrying out the project.

Provision should be made for the teacher or a special co-ordinator to visit periodically the pupil while he is at work; also, to visit him at his home and confer with his parents.

While such an enterprise as the construction of a wireless outfit may be taken as typical of a 'project', it is suggested that a project must not be considered merely as the production of something with the hands. It should be interpreted as any complete task or method of expression. A project must be a complete unity, it must be purposeful, it must have interest, and it must be a part of, or related to, a real situation in life. The pursuer of a project must have a fairly well-defined plan of procedure before commencing action. This plan may change from time to time, but it should always remain an ideal to be sought. A project is a plan of work covering a fairly definite period of time. The work of the project must be organized in such manner as to lead naturally from the known to the unknown. The pursuer of the project must be conscious of the end in view and work to that end. A manual activity that does not result in the completion of a unit or useful object, or a clearly defined differentiated whole to be applied to a useful object is not a project; nor is an activity that only illustrates an idea a project. (This appears to exclude the making of ornamental bric-a-bric.)

The part-time law charges high-school authorities with the responsibility of providing individual counsel and guidance in social and vocational matters for each pupil enrolled in part-time classes. This is one of the most difficult provisions of the Act to administer. It places upon school authorities a great responsibility. Counsel and guidance for the young have always existed. Sometimes this counsel has been good, sometimes bad, sometimes intelligent, and sometimes ignorant. It is the duty of the school authorities to provide as good and as intelligent advice and counsel for these children as is possible. Of course, no one knows enough properly to perform this function. However, it is not a question of absolute perfection on the part of the counselor. It is a question of relative qualification. Certainly an intelligent human being who makes a specialty of the problem can perform better service than is now vicariously provided for these children who leave the school before the age of eighteen. It should be evident that the demands upon a counselor are such as to warrant the development of specialists along this line.

The counselor should possess a good personality, should be tactful, should have common sense, should be democratic, sympathetic, unbiased, and tolerant in his views toward life and toward education. Education should mean for him preparation for human service and not an acquirement of a knowledge of school subjects. He should be a successful teacher, should know something of agricultural, industrial, commercial, and all other common

†See below for explanation of the sense in which this term is used.

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occupations. He should be a student of social life, capable of organizing and conducting the necessary surveys, and analyzing and classifying the experiences of children and prescribing for them the educational program that will fit them best for their duties.

In a small high-school the counselor will probably be the principal or vice-principal, or the teacher in general charge of the part-time classes. In a large high-school, the person placed in general charge of the part-time classes should act as counselor and as co-ordinator of the school and outside activities of the pupils. In large city systems, organizations should be set up for the general administration of part-time classes and for providing counsel and guidance. If these two departments are separately maintained, they should be subject to one general head, since counsel, guidance, education, and supervision of outside activities must be closely tied together.

Working With a 'Dull Cutter'

By An Occasional Contributor

Salesman: "Morning, Mr. Shop Owner, how's tricks?"

S. O.: "Bum. Are you still trying to sell machinery? You might as well quit that game and go on the farm."

Salesman: "What's up? How about that lathe you were talking about?"

S. O.: "Nothing doing, prices are on the toboggan, things have slowed up, and I am going to lay off on the buying. Six months from now lathes will sell for half the price that they are bringing today."

The above is a sample of what is being handed around by a great many people. They are the 'dull cutters' of the metal trades today on the Pacific Coast. There has been a curtailment of work in certain lines and the curtailment has usually been where there is a lack of machinery to carry on the work. Any shortage of material is directly traceable to a lack of machinery in some branch of industry.

Recently in the Bay district a large construction company laid off a number of men and, according to rumor, declared that wages were too high, material scarce, demand for the plant product lessened. In fact any explanation was given that served to illustrate the particular argument of the man who happened to be telling about it. No one seems to know the real reason for stopping the work, so why worry when the matter does not concern you directly and why be pessimistic when you are not posted as to the cause of the lay-off? Assuming that 700 men were laid off by the company, and that all of them were unskilled laborers, how long would it take them to get jobs on other work? If you think that 700 men are going to glut the market it would be well for you to read the 'help wanted' columns in the daily papers.

At the present time there is not a machine-shop in the Bay district that is not waiting for the delivery of a machine or of some material. If labor was plentiful or if the saturation point of machine-tools had been reached, would there be difficulty in securing deliveries of machinery?

The condition of the machine-tool market today indicates that there is neither an abundance of labor nor of material. High-grade tools are still held at three to nine months' delivery and were it not for the stock-tools ordered by the machinery jobbers, the shops would experience long delays in waiting for the machinery they need. No particular credit is due the machinery dealer for carrying the stock he does, but to have his business injured by the pessimistic reports of a 'dull cutter' is hardly his due. There is not a machine-shop in the Bay district which, should it shut down, would have to worry about its men getting work. All of them who wanted to do so could be busy inside of a week at the most, and were the ordinary quantities of supplies that we must obtain from the East at hand they would not have to be out of work a single day.

The present condition, while unsettled, is not one to cause pessimism but rather to stir to action the able business man, the mechanic, the banker, in fact, all of us. There is plenty of labor, plenty of work, plenty of raw materials, plenty of business, but everything is unsettled, and we are in a period of adjustment rather than a period of depression. Judicious business men have profited during the past five years, they have money or means of getting money, the demand for manufactured products is increasing every day, labor is in demand in every branch of industry, the farmer is without help, and realizes that he must turn to mechanical appliances. There never has been a combination of circumstances such as exists at the present time, money, labor, material, and produce all in great demand and yet all are plentiful, the only thing lacking being the conversion of the material through labor into produce and manufactured goods. Although labor is ready, the tools are lacking, and this gives a field for the banker and the business man with money.

The Bay district today needs 'production capital' as it was never needed before. The manufacturing plants of the Pacific Coast were never in a better condition than they are today for the establishing of permanent production plants. Wages in the East are as high if not higher than on the Pacific Coast, freight rates are high and going higher, deliveries from the East are slow and uncertain, we have a greater 'brain power per dollar of wages' than in any other part of the country, so why should we even listen to the pessimist? When I say that labor is plentiful, I do not mean that the full production required can be produced by the labor now at hand with the present equipment, but rather that if the present supply of labor is trained and given the proper tools, enough will be produced to cover our shortage. If the proper tools are purchased, it will not be necessary to lower the wages of the man that can handle the high-production tool.

Get your grinder working, and when you run into the 'dull cutter', touch him up, if you fail to get any sparks, pass him up and keep out of his way, as he may drag you down with him when he goes.

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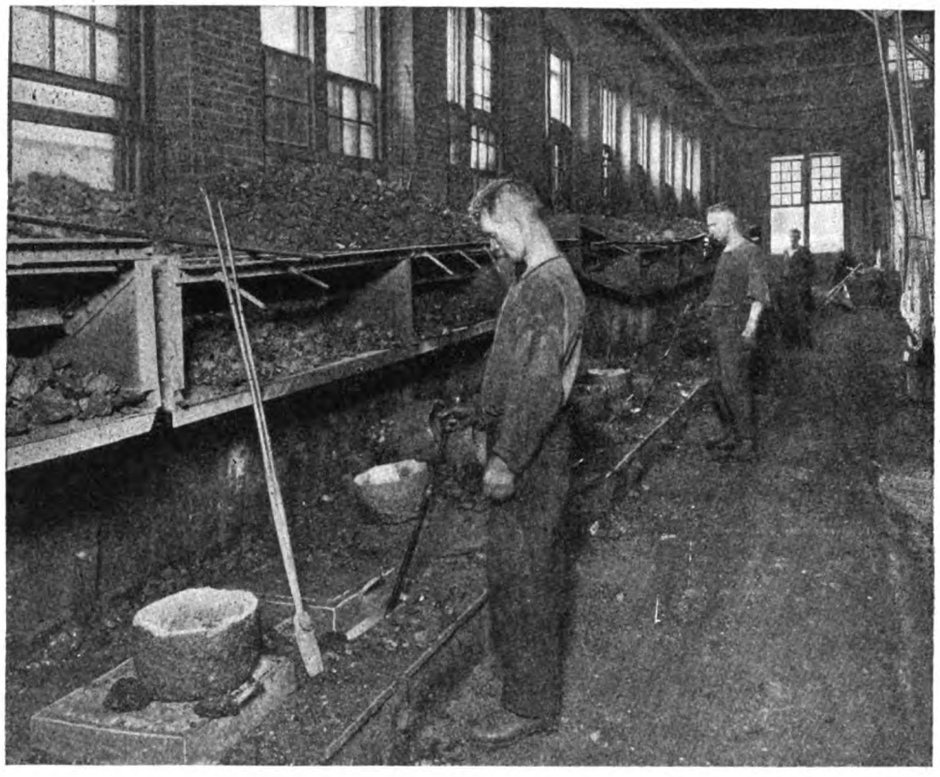
The Electric Furnace in the Brass Foundry

The Bridgeport Brass Co., of Bridgeport, Connecticut, has recently issued an illustrated booklet of about 80 pages, entitled 'Seven Centuries of Brass Making'. The development of brass-foundry practice from the earliest times, and particularly from the Middle Ages, is traced and a description is given of the various processes used at the present time in manufacturing the company's products, which include brass and copper tubing, sheets, rods, and wire. The technology of present-day brass-making is also discussed. The booklet is a valuable contribution to the technical literature of the subject. Perhaps the most interesting feature of the booklet is the comparison of the crucible and the electric process of melting brass, together with a discussion of the reasons that led the company to abandon the use of crucibles in favor of the electric furnace. Some of the principal points of this discussion are given below.



LINE OF PIT-FURNACES

The crucible process is dependent upon the human element at every step. To keep fires going under the usual number of crucibles, putting in the spelter at the right moment, and stirring and pouring at the right moment, is a man's size job. There is a tendency among brass-casters to use time as a guide in the various operations. However, this procedure cannot be relied upon for satisfactory results because of variations in the fuel, in the draft, in the weather, in the condition of the flue, as well as many factors that may render any timing scheme unreliable. In any case, experience is the principal guide in determining when to perform the various operations, and there is no certainty that a man will always do even as well as he knows how. In other words, the character, disposition, and moods of the men, as well as their experience, enter into the making of brass by the crucible process.

Next in order of importance among the disadvantages of the crucible process is the fact that bad working conditions are practically unavoidable. Even with the best ventilation, the men are subjected to noxious fumes and extreme heat, and the more conscientiously they do their work, the worse the conditions they must endure.

The crucible itself is often the cause of discrepancies in the quality of the metal, due to the fact that a slight leak may permit part of the mixture to escape. The proportions are also modified by various conditions that affect the volatilization of the zinc. In addition, the composition is affected by the furnace-gases to which the molten brass in the crucible cannot help but be exposed. These gases usually oxidize the ingredients of the mixture and thus introduce impurities, besides removing part of the metal.

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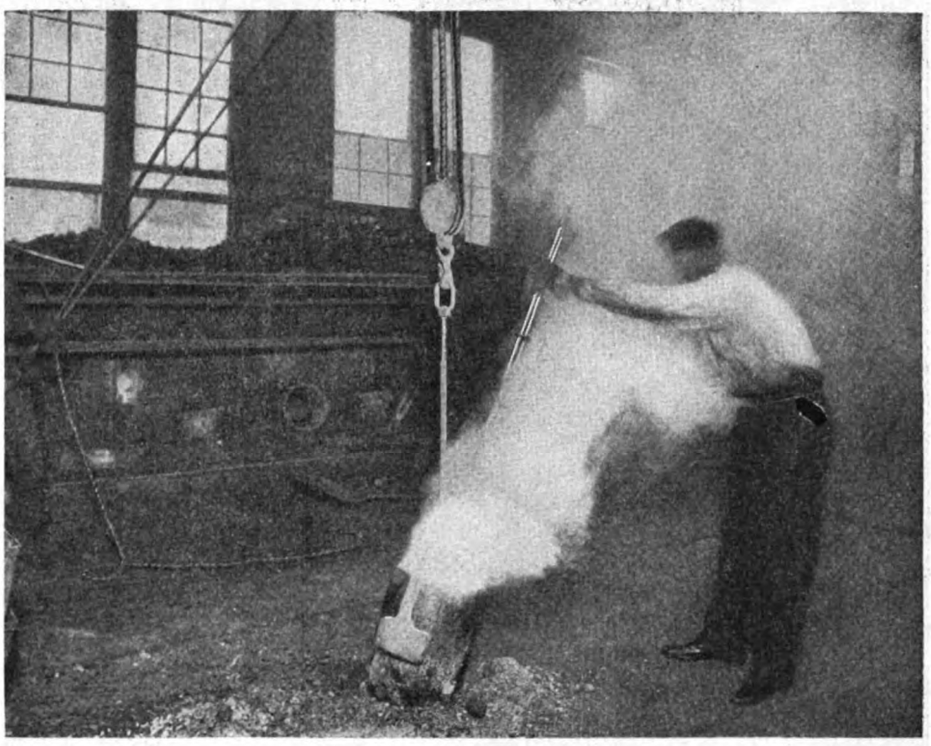
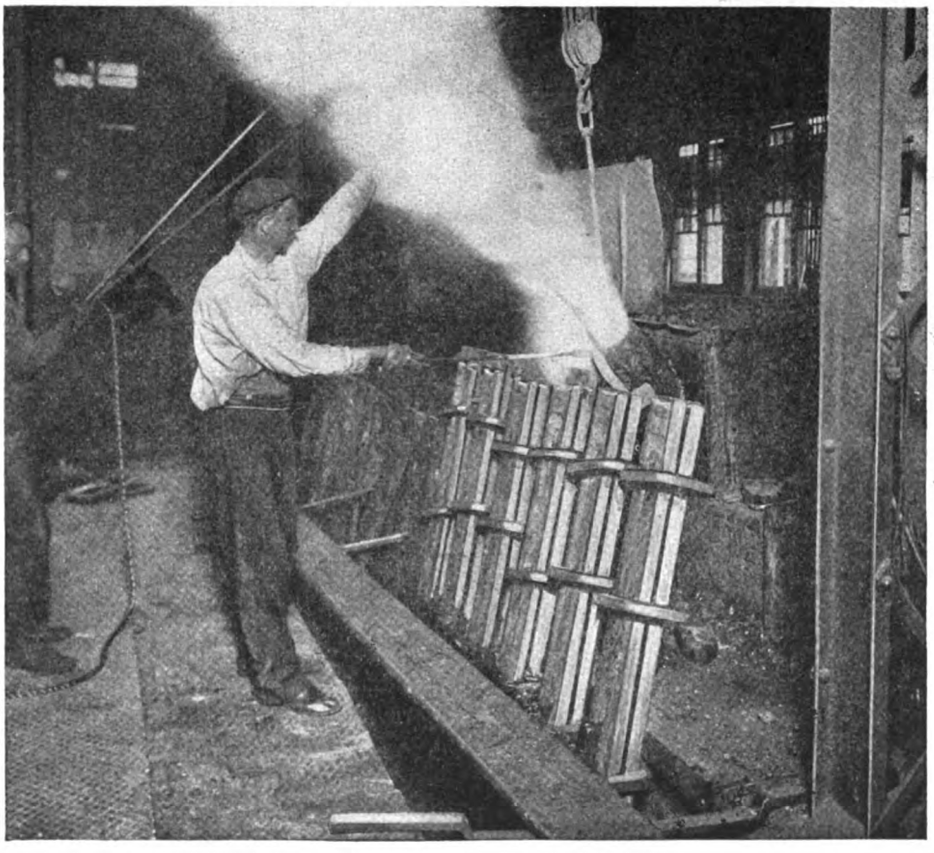


SKIMMING A CRUCIBLE. THE SMOKE IS MAINLY ZINC OXIDE, AND IS ONE OF THE WORST FEATURES OF THE CRUCIBLE PROCESS



POURING FROM CRUCIBLE. THE SKIMMER-IRON IS USED TO HOLD BACK THE DROSS, WHILE THE POURING IS CONTROLLED BY THE TONGS

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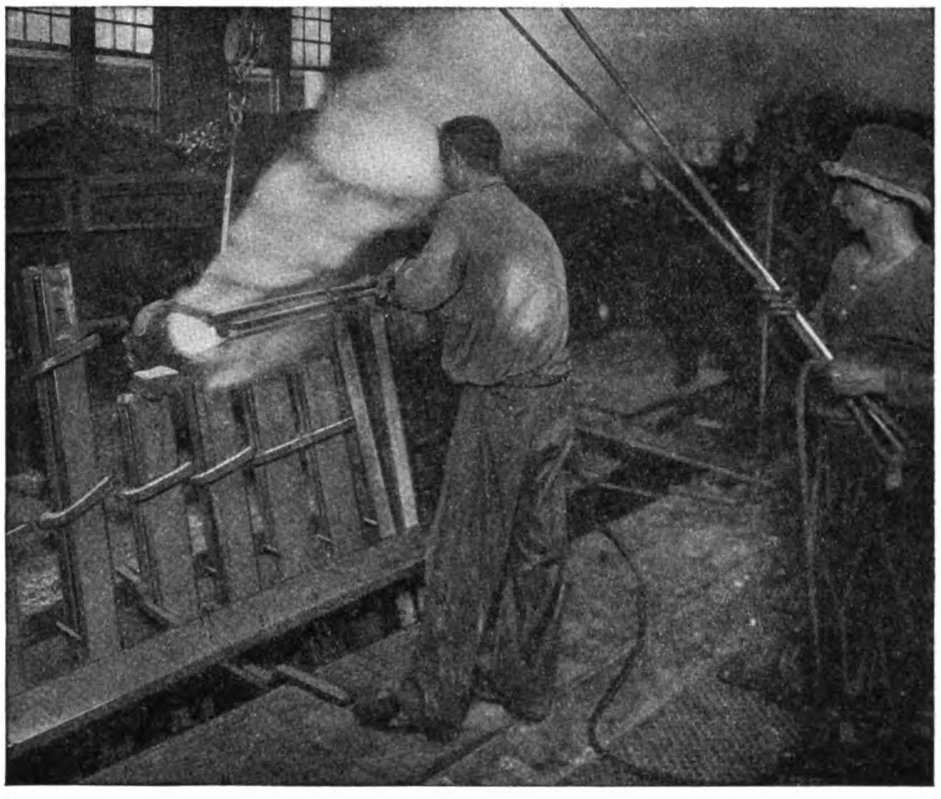
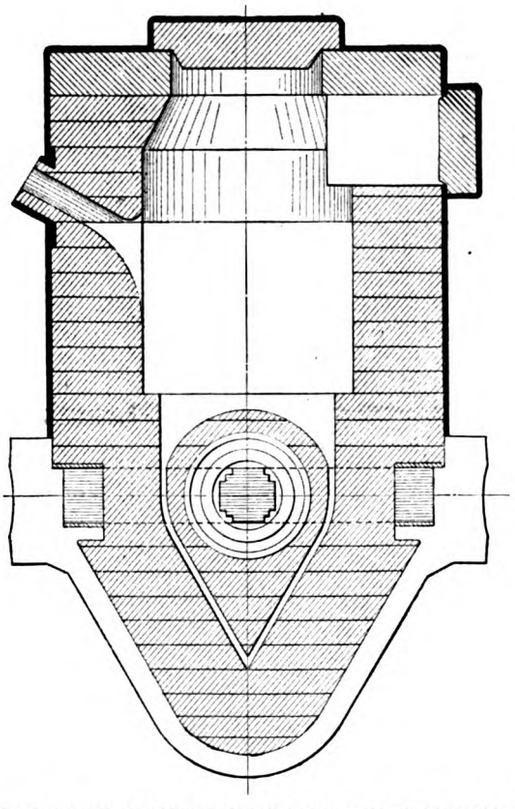


POURING FROM CRUCIBLE. NOTE PARTICULARLY THE ROD AND ROPE CONTROLLING THE JIB-CRANE SUPPORTING THE CRUCIBLE



ELEMENTARY DIAGRAM OF WYATT HEATING-FURNACE

In fact, the crucible process is not susceptible to scientific control and therefore cannot be admitted as a satisfactory manufacturing process for the making of a uniform high-grade product. Its possibilities are dependent entirely upon the individuals operating it, and the product can be controlled only by thorough inspection and by conscientious rejection of all metal below the standard.

In the consideration of the comparative merits of melting brass in crucibles or in the electric furnace, as well as the selection of a type of furnace, the following facts are of importance:

All electric furnaces eliminate the possibility of contamination of the metal from furnace-gases, since no fuel is used and therefore no gas generated.

All electric furnaces possess the possibility of heat-control, but not all possess even the possibility of temperature-control when the question of temperature-distribution is considered. In brass-making, temperature-distribution is of first importance, and a furnace that does not transfer rapidly the heat input to all parts of the metal without superheating any local part cannot be successfully employed.

On account of the fact that spelter floats on copper, it is necessary that provision be made for stirring the metal, and not all types of electric furnaces possess even the possibility of providing in a practicable way for this essential operation.

All types of electric furnace may be so insulated as to eliminate disagreeable high-temperature conditions for the workmen. Also any type of furnace may be mounted mechanically so as to facilitate the charge and pouring of the metal.

All types of electric furnace offer the possibility of enclosed operation, although the commercial realization

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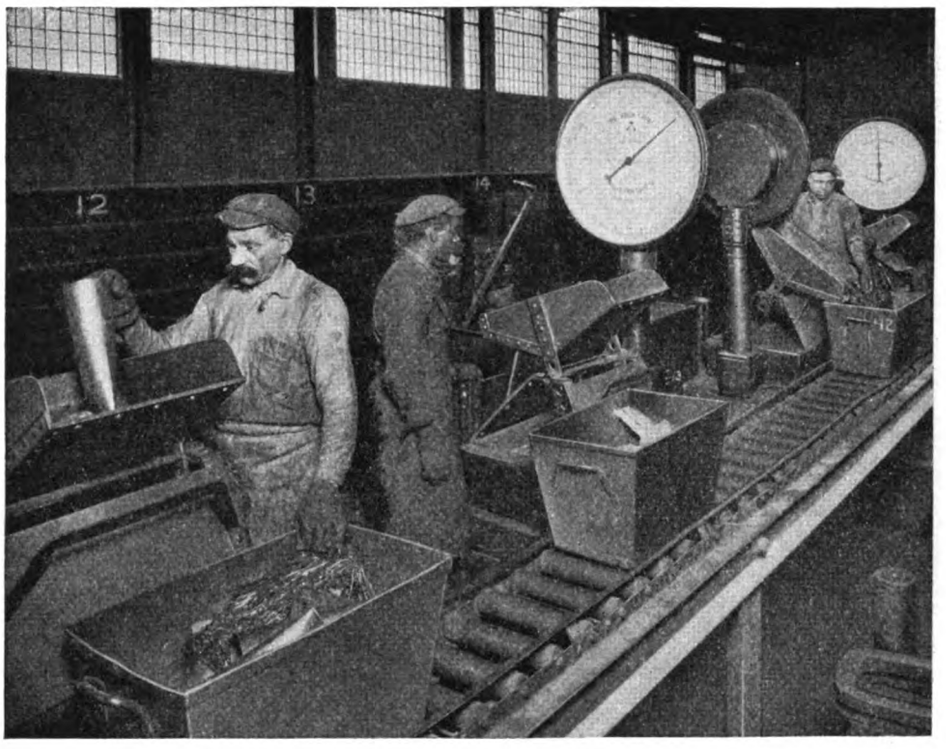
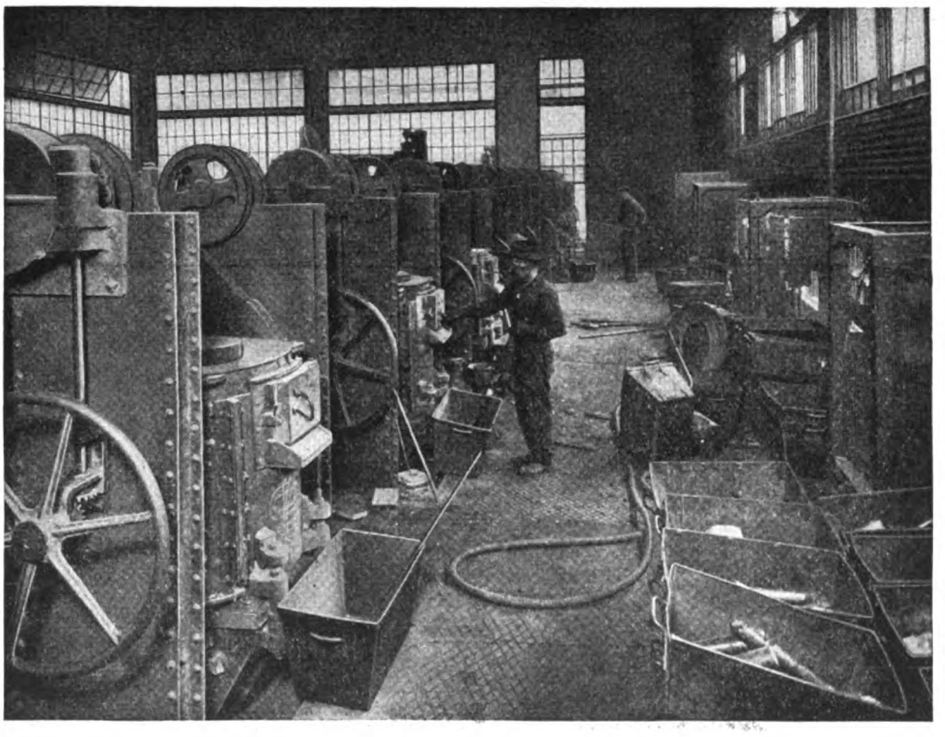


LINE OF WEIGHING-MACHINES IN THE BRIDGEPORT PLANT

of this possibility is not always feasible. Loss of zinc depends not only upon enclosing the space above the surface of the molten metal, but also upon the temperature distribution, the pressure, and the length of time that the metal stands in a molten condition. Consequently the reduction of the loss of zinc depends upon the design of the furnace rather than upon the mere fact that an electric furnace is used.

In short the electric furnace offers the possibility of applying scientific principles in a commercial way; that is, an electric furnace designed to utilize all the possibilities presented should practically eliminate the per-



CHARGING-AISLE FOR ONE BATTERY OF ELECTRIC FURNACES AT THE BRIDGEPORT PLANT. CHARGING-CANS ARE SHOWN ON THE RIGHT

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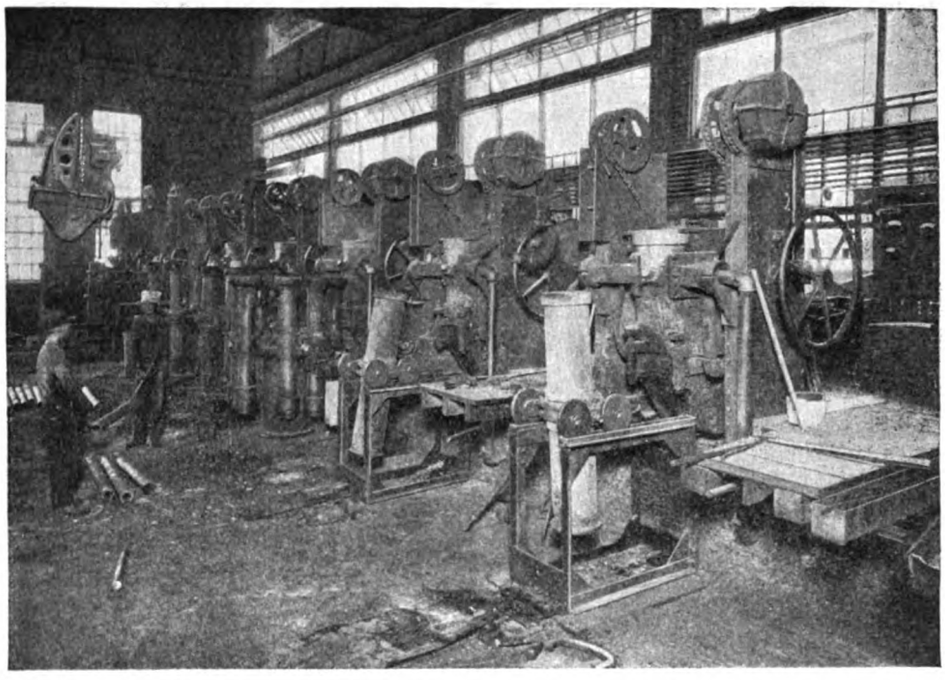


POURING-AISLE OF BATTERY OF ELECTRIC FURNACES AT THE BRIDGEPORT PLANT

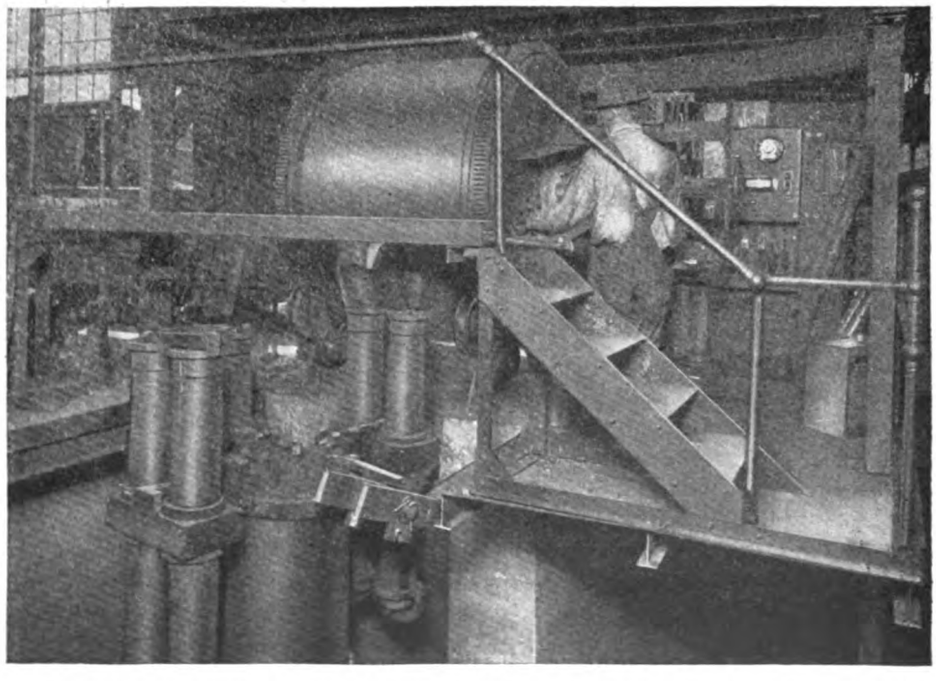
sonal element of the operator and render the process susceptible of accurate control in accordance with carefully prepared plans.

From a metallurgical standpoint electric furnaces may be classified as follows according to the method of heat production:

1. Heat produced exterior to the metal to be melted.
2. Heat produced on the surface of the metal to be melted.
3. Heat produced within the metal to be melted.

The first method includes the separate resistor-unit type in which the heat is generated in a special resistor and conducted to the metal to be melted through the walls of the hearth and by reflection from the arch or dome of the furnace. Special provision for stirring must be made with this furnace. The heat transfer from the surface toward the interior does not give favorable conditions for uniform temperature-distribution through the mass of the metal.

Another type of exterior heat generation is the in-



POURING BILLET FROM AN OSCILLATING INDIRECT-ARC FURNACE. RAW MATERIAL IS CHARGED FROM ABOVE. POURING IS GOVERNED BY AN ELECTRIC CONTROLLER

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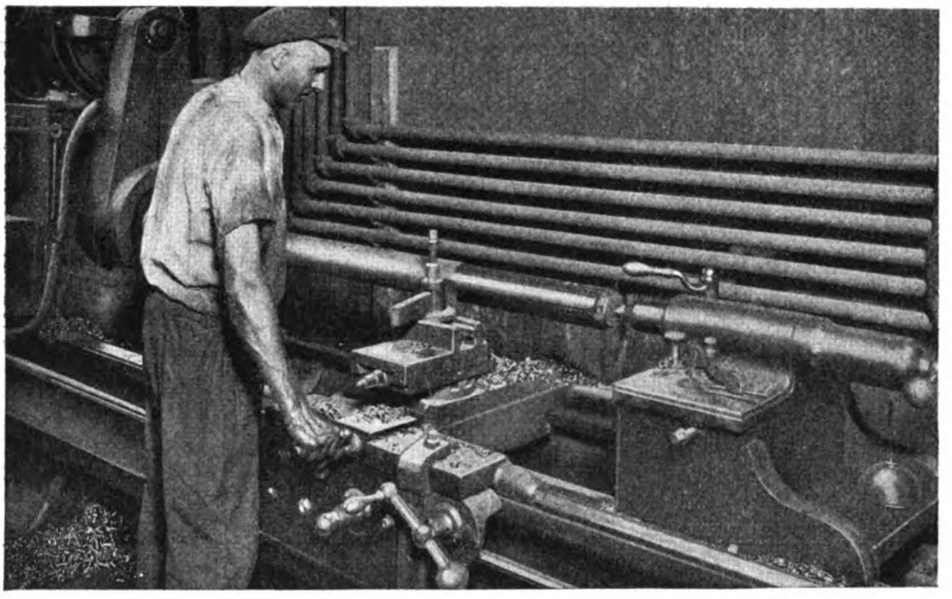


TAKING CUT OFF BRONZE-BILLET OF SPECIAL TURBINE-BLADING METAL

direct arc. This type is open to the same objections as those already mentioned under the resistor type, except that the source of heat being more concentrated, the tendency toward local overheating of the metal is correspondingly greater. In one type of indirect-arc furnace, this tendency is combatted by constructing the furnace in the form of a cylinder swung on its long axis, and rolling it continually first in one direction and then in the other. Another type rotates continuously in the same direction.

The second type of furnace in which the heat is generated at the surface is represented by the direct-arc. On account of the excessive concentration of heat production this type of furnace is not suitable for brass-melting.

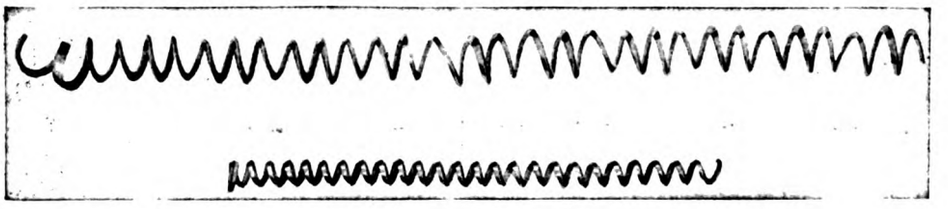
In the third type, the metal itself is utilized as a resistor and the flow of electricity through the metal may be established by induction from a primary winding, or else the electricity may be introduced through electrodes. The disadvantage of this type of furnace is that a molten charge is necessary to start it. This type of furnace can be so constructed that it will automatically circulate the metal.

This type of furnace was adopted by the Bridgeport company for high-zinc brasses, using as a heating element the induction unit invented by J. R. Wyatt, and controlled by the Ajax Metal Co. In the Wyatt heating element, the primary is connected with the alternating-current source and may be wound for any commercial voltage. The secondary consists of a V-shaped mass of metal confined to narrow passages on two sides and open on the other side. In the narrow passages three forces operate, namely, pinch-effect, motor-effect, and gravity-effect. The head of molten metal above the 'V' in the chamber of the furnace prevents the pinch-effect from actually rupturing the circuit, although it does cause contraction, which in turn causes motion of the column in the direction of least resistance. Contraction also causes the generation of extra heat, which further accentuates the motion.

At any instant the electric current in the two converging channels is in opposite directions. Therefore, a repulsion, called motor-effect, is produced between the two, which tends to throw the liquid out of the passages. Observation has shown that the liquid rises along the outside surfaces of the passages and descends along the inside surfaces.

The application of heat at the bottom of the mass of metal causes circulation, which draws the colder metal continually to the bottom and in this way effectively distributes the heat throughout the mass. The combined effect of these three actions is to cause a violent propulsion of metal out of both legs of the triangle, which mixes the charge and carries the heat to all parts of the bath.

For bronze alloys and the special 'phono-electric' alloy made by the company for trolley-wire, an indirect-arc



CHIP REMOVED FROM BILLET SHOWN ABOVE, ILLUSTRATING QUALITY OF METAL

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furnace of the Gillett type is used. This furnace is built in the form of a cylinder, and is mounted in a cradle so arranged that the furnace is rotated automatically first in one direction and then in the other. The electrodes enter in the centre of the two ends and coincide with the axis of rotation.

By the use of these types of furnace, the company is able to accomplish the following objects:

1. All factors entering into production susceptible of exact determination and control, practically eliminating the human element.
2. Uniform temperature-distribution through the metal.
3. Thorough stirring and mixing obtained.
4. Temperature of metal always indicated electrically, making estimates of temperature unnecessary.
5. Heat input under perfect control. Same heating conditions can be repeated indefinitely.
6. Furnace-chamber completely enclosed, ensuring purity of metal.
7. Heat insulation so perfect that the operator can lay his bare hand on the outside of the furnace.
8. Slight errors in weighing of ingredients minimized by the practice of pouring only part of a charge at a time and then re-charging.
9. Complete control of pouring.

The procedure in the company's brass-casting shop is as follows: At one end of the shop are situated the metal bins in which the raw materials are stored. These are classified according to analysis. In order to simplify the operation of weighing the ingredients each ingredient is handled by a separate workman. The equipment for weighing is so designed that the material after being weighed is dumped directly into the charging-can in such a manner as to eliminate the loss caused by careless handling. As a further check on weights, the complete charge is weighed before it is sent to the casting-shop, and if the total weight does not check with the sum of the required weights of the ingredients, the charge is reassembled. The charging-cans are made of such a size that the charge fills them to less than half their capacity, thus eliminating the chance of spilling over the sides. The cans are brought to the line of furnaces by means of an overhead traveling-crane. The furnaces are charged through doors near the top. When the metal is ready to pour, the molds mounted on a rotating stand are put in place and pouring is accomplished by manipulation of a hand-wheel. This wheel is geared positively to the tilting-mechanism, so that the caster has perfect control of the rate of pouring. A sample is taken from each melt, and the results of the laboratory analysis of this sample are available before the billets or bars, as the case may be, reach the mill where they are worked into the finished product.

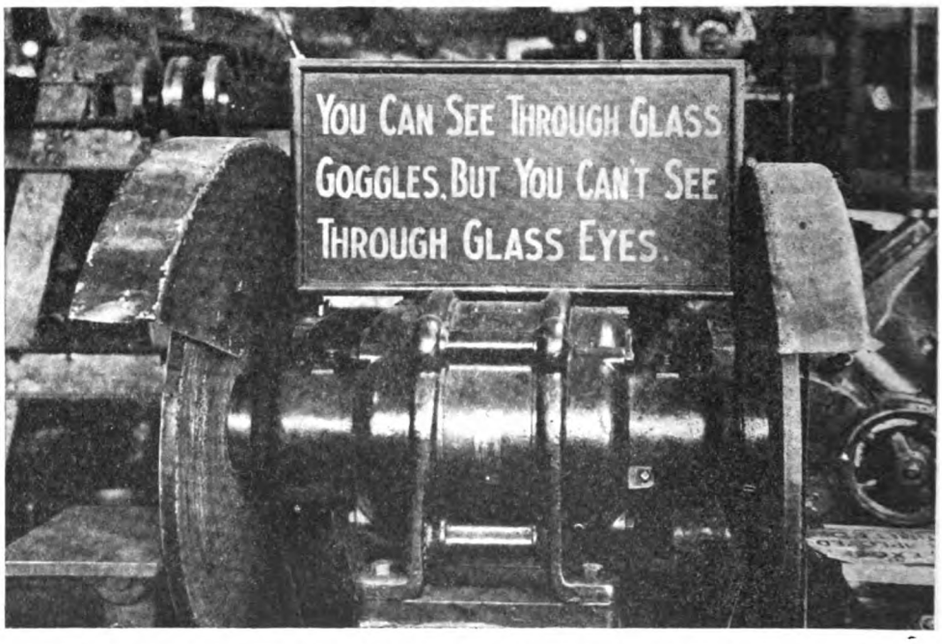
The Yampi Sound Iron Deposits of Australia

From time to time there have been stories current of enormous areas of iron ore at Yampi Sound, in north-western Australia. Recently the State Government dispatched expert mining engineers to examine them, and report has just been made by Mr. Montgomery, who estimates the amount of iron ore available, that is, in sight above sea level, at 97,000,000 tons. The quality of the ore is exceptional. Assays show that the proportion of iron runs from 60.91% to 68.99%. There is only 1% of silica present and little sulphur.

Yampi Sound is described as a splendid harbor. The ore could be quarried, as Mr. Montgomery points out, and run down chutes by gravity into the ships' holds, as there is deep water right up to the base of the deposits. —London 'Times'.

Safety Sign for Grinding-Wheel

The 'Safety-First' policy of the Southern Pacific Co. is too well known to require lengthy description, and the company's shops at Sacramento are no exception to the general rule. Special stress is laid on the use of goggles wherever there is danger of eye injuries. Besides the usual means of warning cards, and safety regulations posted in conspicuous places supplemented by admonitions from the foremen, the sign shown in the accompanying illustration is painted in white letters on a red background, and placed on every grinding-wheel throughout the shops, thus keeping before the mind of every man using a wheel the fact that the use of goggles is to his interest.



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THE HETCH HETCHY VALLEY

The Hetch Hetchy Project

Although primarily an outside construction enterprise, the Hetch Hetchy water-supply project of the city of San Francisco, is requiring and will require so much machinery and metal products for its construction as to be of special concern to the men in the metal industries of the Pacific Coast in general, while those in the Bay district in particular have even greater reason to be interested.

The project in its essential features comprises the following:

A dam at the Hetch Hetchy valley, which will ultimately be 312 ft. high above the stream-bed, and whose foundation will extend 72 ft. below the stream-bed. At first the dam will be built to a height of 226 ft. above the stream-bed. The total amount of concrete will be 365,650 cu. yd. and the total cost, $5,447,792.50.

An 18-mile tunnel from Early Intake to Priest. Just below Priest, the water will be dropped 1215 ft. to the Moccasin Creek power-plant, developing 66,000 hp., more than the present total consumption of power in the city of San Francisco.

A standard-gauge railroad 68 miles long, laid with 60-lb. rails, extending from Hetch Hetchy Junction on the Sierra railroad to the damsite. After the project is completed, the rails on part of this line will be removed and the road-bed used as part of a boulevard running to both the Hetch Hetchy and Yosemite valleys.

An aqueduct from the Moccasin Creek power-plant to San Francisco. The total length from Early Intake to San Francisco will be 156 miles, 89 miles in tunnels, 10 ft. 3 in. diam., and 67 miles in steel pipe.

In addition there is the Lake Eleanor project, comprising a dam 70 ft. high, a canal and flume 3 miles long, and power-plant developing 4500 hp. Besides this there is a saw-mill cutting timber on the property of the City for use on the construction, transmission lines for power, the shops, warehouses, and general headquarters at Groveland, and many other minor features.

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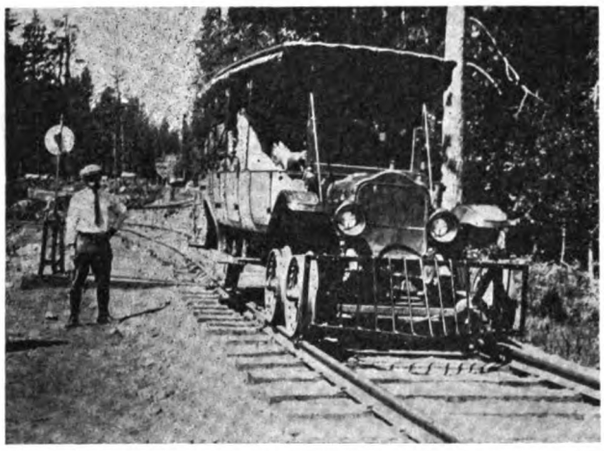
At the present time, the Lake Eleanor project is completed and is supplying all the power needed for the construction, together with a small surplus, which is being sold to a private company. A diversion tunnel and diversion dams have been completed at the Hetch Hetchy damsite, unwatering the foundation for the dam, where work is under way removing the loose rock and other material above the bedrock. The main tunnel is being driven from five points, three portals and two shafts. The railroad has, of course, been in operation for some time. No work is being done below the Moccasin Creek power-plant, efforts being concentrated on the completion of work above that point, which will probably be in about three years. This will make a large amount of power available for sale, bringing in direct revenue to the City, which will go a long way toward meeting the interest on the bonds.

A notable feature of the work is the use of labor-saving machinery wherever possible. Men are too expensive



CONVERTED AUTOMOBILES USED FOR PASSENGER TRANSPORTATION ON THE HETCH HETCHY RAILROAD. IS THIS A SOLUTION OF THE PROBLEM OF THE SHORT-LINE LIGHT-TRAFFIC RAILROAD?

and too scare now to be used where a machine can be substituted. Particularly noticeable in this regard is the way in which the tunnel work is being handled. Since the machine-drill came to its present development, the great problem of miners and construction engineers driving small and moderate sized tunnels has been to keep the shoveling up to the drilling, and it was seldom if ever solved satisfactorily as long as reliance was placed on man-power. Only a few men can work to advantage shoveling in a tunnel. To add to the number simply causes them to get in each other's way. To meet the situation, loading machines operating somewhat like a small steam-shovel were obtained, of two different models, one made by the Myers-Whaley Co., of Knoxville, Tennessee, and the other by the Superior Loading Device Co., of Superior, Wisconsin. One of these was placed in a heading where four shovelers had required an eight-hour shift to get out 22 cars of rock. The machine loaded 30 cars in three hours. It cost $9000, but it will pay for itself soon at that rate. Everywhere the same tendency to use machinery is in evidence. At the damsite a steam-shovel loads the broken rock directly on to cars, and an industrial locomotive hauls them to the dump. In the vicinity are several men with 'Jackhamer' drills working to clear the loose rock from the foundation. In the tunnels, compressed-air drills break the rock, which is loaded on cars by the machines already described and is hauled to the dump by small storage-battery locomotives. Wherever work is under way compressors are furnishing compressed air for the work, while at the Lake Eleanor project power-plant, Pelton wheels and generators furnish power. Each blacksmith-shop along the line is equipped with a drill-sharpening machine to ensure that the drills are kept in the best condition, while well-equipped machine-shops are maintained at Groveland and at the damsite for general machinery repairs.

Roughly speaking, about $1,000,000 worth of machinery and machine-tools will be in use for the actual construction. In the power-houses and elsewhere along the line about $3,500,000 worth of machinery will be installed permanently. In the pipe-lines, 35,000 tons of steel will be used. This is all in addition to the equipment of the railroad, including between 6500 and 7000 tons of steel rails.

Proposed Standardization of Sizes of Shafting

After several months of investigation, a committee of the American Society of Mechanical Engineers appointed to investigate the possibility of reducing the number of sizes of shafting carried in stock has rendered a progress report. The report deals with both transmission-shafting and machinery-shafting. Data were secured from the principal manufacturers, dealers, and users regarding the sales of the various sizes rolled, and it was found that of the 50 or 60 sizes, all but 14 could be discontinued without inconvenience to the trade. A similar investigation of machinery-shafting showed that the number of sizes in that line could also be reduced materially. The recommended sizes are as follows:

Transmission-shafting: $\frac{15}{16}$ in.; $1\frac{3}{16}$ in.; $1\frac{7}{16}$ in.; $1\frac{11}{16}$ in.; $1\frac{15}{16}$ in.; $2\frac{3}{16}$ in.; $2\frac{7}{16}$ in.; $2\frac{15}{16}$ in.; $3\frac{7}{16}$ in.; $3\frac{15}{16}$ in.; $4\frac{7}{16}$ in.; $4\frac{15}{16}$ in.; $5\frac{7}{16}$ in.; and $5\frac{15}{16}$ inches.

Machinery-shafting: Size intervals extending to $2\frac{1}{2}$ in. by sixteenths of an inch; from $2\frac{1}{2}$ to 4 in. by eighths; from 4 to 6 in. by fourths.

The adoption of these sizes will not make it impossible to secure any other size required on special order, but it will reduce mill-costs by decreasing the number of sizes to be rolled and thus lengthening the runs on any one size, and will reduce warehouse costs by decreasing the amount of material to be kept in stock, not only of shafting itself, but also of accessories such as hangers, bearings, collars, bushings, etc. The proposed sizes have received the approval of both manufacturers and consumers.

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Re-Educating the Disabled Soldier

SELLING pencils and shoe-strings as a means of livelihood by disabled veterans is out of date. The United States, like most of the other countries in the War, is committed to the policy of training disabled service-men so that they may become self-respecting and self-supporting citizens. This article tells about the work of the Rehabilitation Division of the Federal Board for Vocational Education toward that end, and also tells how the men of the metal trades can co-operate with the Board.

One of the few partly compensating features of the War, and one in which it differs from previous wars, is the determination expressed in every important belligerent country that the man wounded or otherwise disabled in the struggle shall not be simply turned adrift with a more or less inadequate pension, but shall be given an opportunity to receive training fitting him to make the greatest possible use of his remaining faculties.

Rehabilitation, which is mainly re-education, of disabled service-men, was begun in the European countries even before the United States entered the War. Lack of man-power was the compelling cause. Just as many of the slightly wounded returned to the trenches after a short time in the hospitals, so many others, who were too seriously injured to resume active service, went to work back of the lines or in munition factories, doing such work as they were able to do. Most of these men were unable, on account of their injuries, to do the kind of work to which they had been accustomed, and required training or re-education before they could take up the work that their disabilities compelled them to do. This led finally to the adoption of a policy or re-training all men incapacitated by reason of their disability from resuming and carrying on their old occupations in civil life.

As soon as the decision to send an Army abroad made it evident that there would be a large number of American wounded, Congress made provision for re-training, and this work was placed in charge of the Division of Rehabilitation, of the Federal Board for Vocational Education. For purposes of administration the country is divided into 14 districts. Headquarters for the district including Nevada, Arizona, and California are in the Flood building, San Francisco.

A man becomes eligible for training upon discharge from the Service, or at any time thereafter, provided that as a result of his service he has acquired a disability that prevents him from engaging in his previous occupation. A single man approved for re-training receives an allowance of $80 per month for living expenses, plus tuition fees, cost of books, and other outlays directly connected with his re-training. Additional allowances are made to married men or to men with other dependents. Legislation has just passed that will increase this base allowance from $80 to $100.

Data regarding the applacant for vocational training are collected and entered on one blank (Form 502), and forwarded by the local office to Washington. The information required covers the man's military record, his disability, his education, occupation followed before, during, and after leaving the Service, his war-risk insurance, his present employment, if any, possible prospective employment, his preference for future occupation, his economic status, his general personal characteristics. The reasons for obtaining most of this information are most of them self-evident. The principal reason for inquiring into the applicant's economic condition is in case he wishes to go into business, when the amount of capital or financial backing available may be all important. Space is also provided on the blank for recommendations by the Vocational Adviser and the Supervisor of Advisement regarding training. When the application has been approved, the applicant enters his training, and commences to receive his allowance-checks.

Recommending the particular line of training to be followed is one of the hardest tasks of the staff of the Board. While there are some exceptions, the problem is relatively simple when the man has a well-defined preference. However, this is seldom the case. The interviewer finds the applicant does not know what he wants to do.

For the cases where questioning and observation have been unsuccessful in determining good reasons for a recommendation, a 'vocational guidance school' has been established in connection with the State Polytechnical School at San Luis Obispo. Here a man may go and try his hand at the rudiments of several trades and occupations until it is possible to determine which one he should follow.

Another important point in connection with recommendations for training is the opportunity for getting a job in the particular occupation in the district in which the applicant lives. The staff of the Bureau will hesitate to recommend training in an occupation where the opportunities for obtaining employment appear to be poor.

When a man has selected an occupation and has been duly certified, the staff of the Board has to find means for training. There are two general methods, in schools and on the job itself. In either case, the staff exercises a general oversight of the man's training, encourages him when he becomes disheartened, sees that the employer actually trains him instead of simply taking advantage of an opportunity to get a cheap man for unskilled work, and generally looks after the soldier's interests. It is not easy for a grown man of small education, without much physical vigor, and who probably never was really

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studious, to buckle down to hard study of a trade or profession, and many of them become discouraged, and want to 'chuck the whole thing'. The first two months or so are the hardest, and if the man can be carried along for that length of time, he usually gets into the swing of things, but to keep him contented during the period is frequently a task calling for all the tact possessed by the man in charge of his case.

Experience of firms that have been willing to make an effort to place men having physical disabilities indicates that there are few if any men for whom no occupation can be found. The Ford Motor Co., as is generally known, is making perhaps the greatest efforts along these lines, no man not having a contagious disease being refused employment because of physical disability. The statement has been made that recently two totally blind men applied for work. After some investigation, they were put to work counting and sorting bolts of various kinds. In a short time the two were turning out more work than the three able-bodied men formerly on this job, who had been transferred to another department.

Incidentally, it might be mentioned that the proportion of seriously disabled men among those needing training has been greatly exaggerated in the popular mind. In the entire American army there were only 140 cases of total blindness. Even major amputations are relatively uncommon compared to the proportion in the Allied armies. The proportion of tubercular cases among those in this district is large, and will probably increase, as there is a tendency among consumptives in other parts of the country to come West. While, of course, no man is started on training until the tubercular tendency is, at least, arrested, these men require careful oversight or they will work beyond their strength. Of those receiving training of various kinds at Stanford University during the past year, the man making the best record was tubercular, but he had to go to the hospital again soon after the close of the term. In fact, the man with tubercular tendencies is almost invariably too ambitious for his own good. Care is required in selecting work for gassed men. They should have as much fresh air as possible, and particularly should not be exposed to gas or fumes of any kind. Even getting too near an automobile exhaust may send a gassed man who has been apparently in normal health back to bed.

So far the work of the Board has been mainly in training, as comparatively few men have gone far enough to be ready for placement in regular occupations. However, placement is going to become more and more important, and the employers of the Pacific Coast, in the metal trades, as well as in other lines, must be ready to 'finish the job' by standing back of the men that went to France when their country needed them. This requires that a survey of each plant be made in order to determine what jobs can be filled by physically handicapped men, and furthermore that when men physically handicapped because of their service to their country apply for work, they be given an opportunity in the jobs for which they are suited. Experience so far has indicated that the union officials are ready to co-operate in every reasonable way in the waiving of apprenticeship limitations and similar restrictions.

The work that the Federal Board is now doing for the disabled soldier is only a forerunner of the work that soon will be done for those disabled in industry as well. Legislation has recently been made effective appropriating Federal funds to be used in conjunction with State and local appropriations for this work. To allow a man to be injured in any way and then fail to train him for the most useful work he can perform in his handicapped condition is economically as well as morally wrong.

Profit-Sharing in England

The British official 'Labor Gazette' recently contained a summary of a report prepared by the Ministry of Labor on Profit-Sharing in the United Kingdom. The number of schemes in existence on October 31, 1919, was 182, and the number of employees affected was about 250,000. These 182 schemes were the survivors of 380 started at one time or another since 1865, with an isolated example in 1829. Of the 20 schemes started before 1870, only 3 survived. Of the schemes in existence at the time of the report, 29 had been started during the ten months ended October 31, 1919. The greatest activity in the formation of profit-sharing schemes was shown between 1889 and 1892. In fact, the profit-sharing movement is marked by a succession of violent fluctuations.

Abandonment of profit-sharing has frequently been caused by the inability of the firm to earn sufficient profit to make profit-sharing a success, but in 91 cases out of the total of 198, lack of success is attributed to dissatisfaction on the part of employers or employees. The amount of profits distributed for 93 firms during the year 1918 was $1,277,340. These firms employed a total of 83,210 workers, of whom 64,930 were entitled to participate. Of these, 76 firms employing 51,550 employees, 35,153 of whom were entitled to participate, had been sufficiently successful to permit the payment of some bonus. The total amount paid was about $36 per employee receiving any bonus, or about $20 per employee allowing for those entitled to participate but employed by firms unable to distribute a bonus. Eight firms, employing 5833 workers, were able to distribute a bonus exceeding 20% of the year's wages. The average bonus, allowing for those entitled to participate, but receiving no bonus, was 5.1% of a year's wages.

"WHAT is your name?" asked the judge of the prisoner.

"Joshua," replied the prisoner.

"Joshua?" repeated the judge. "Ah! Are you the Joshua who made the sun stand still?"

"No, sir, judge," was the answer. "I is the man who made the moon shine."

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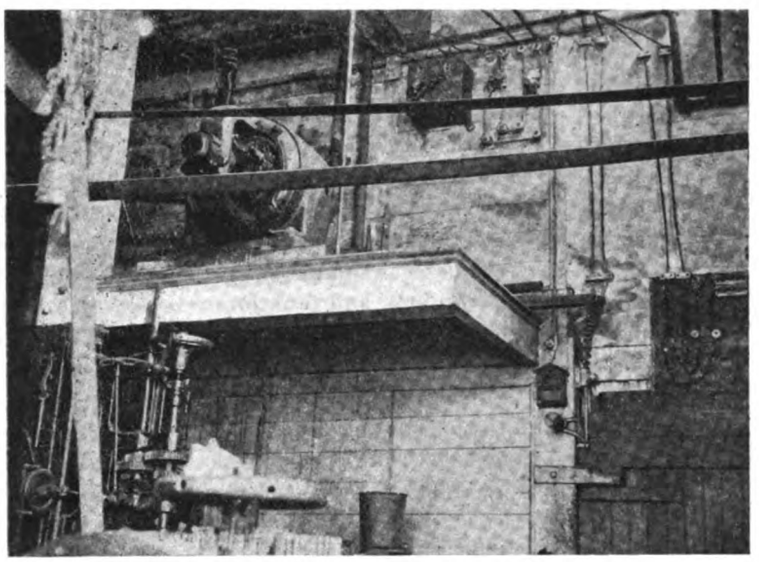
Necessity for Accessibility of Switches and Control-Devices*

By G. E. KIMBALL

It is important that all motor-control devices, disconnecting switches, and automatic cut-outs be placed where they will be readily accessible. Many serious accidents might have been avoided if some thought or regard had been given to the placing of control-devices. This question should be given serious consideration and every effort be made to rearrange the equipment so that the operator will not be unnecessarily exposed. It is important that the motor-starting device be situated where the machine and the motor will be in plain view of the operator. This is sometimes impossible where the machinery and shafting are not on the same floor or where belt-conveyor, grain-elevators, flour and rice-milling machinery, or similar equipment extend over several floors and are all operated as a unit by one motor. Under such conditions a signaling system must be provided to give warning to any employees that may be near the machinery or shafting when the motor is started. The motor-starting devices must be equipped with no-voltage release protection, which will automatically return the starting-handle to the 'off' position when the current fails. When the equipment operated by one motor is widely scattered an 'emergency-stop' circuit should usually be extended from floor to floor or provided at several easily accessible positions.



STARTING-RHEOSTAT FOR MOTOR ABOVE THE MOTOR PLATFORM. THE PLATFORM CANNOT BE REACHED WITHOUT A LADDER. IT IS OBVIOUS THAT THERE ARE OTHER CORRECTIONS REQUIRED.

It is evident that the electrical equipment was considered of secondary importance in many of the older plants. Great care and attention had been used in placing each machine to the best advantage. In some cases, every consideration had been given to the handling of material or to the process of manufacture but the starting-equipment for the motor was behind a belt, a pulley, a flywheel, or a gear. Again, the starting equipment would sometimes be placed under the machine and would be practically inaccessible. It was common practice to place the starting-equipment over an opening in the floor or else many feet from the machinery and entirely out of reach of the operator in an emergency. In other cases the starting-switches were on an elevated platform with the motor, where it was impossible to reach the device without a step-ladder. If the law did not require that all motor-controlled devices, disconnecting switches, etc., be placed where they were readily accessible, common sense should at least show that it is an important requirement.

In designing and installing power-distribution panels and in placing disconnecting and control devices, it should be carefully noted that the height of the switch-handle should not be more than six feet above the floor or platform level and that the space in front of this distribution centre be reserved exclusively for a working space. If the floor-space is of such value that it is not an economic plan to reserve the necessary space and if it is possible to place the distribution at some advantageous overhead location, a permanent platform must be provided with regulation hand-rails and toe-boards and a permanent ladder or stairway as required in the General Safety Orders. If floor-openings are necessary in this platform, they must not be directly in front of the distribution centre, as that would be a serious hazard in the event of a mis-step and might easily cause a fatal accident.

The ladder or stairway should extend to the end of the platform and there be permanently and safely fastened in place. To reach the disconnecting switch in an emergency, it should not be necessary to search the plant for a step-ladder. When the platform is reached the various disconnecting switches should be plainly marked identifying them with the circuits that they control, so that anyone, even if entirely unacquainted with the shop, may be able to throw off the current in case of an emergency.

*From 'California Safety News'.

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Composition of Stellite or Stainless Steel*

By ELWOOD HAYNES

In 1899 I produced an alloy consisting of practically pure nickel and pure chromium by heating their mixed oxides with aluminum. This alloy, when polished, retained its lustre, even in the atmosphere of a chemical laboratory, and proved to be practically insoluble in nitric acid, even when boiling. It is also malleable when cold, and under proper annealing can be worked into sheets and wire.

Shortly afterward, an alloy of cobalt and chromium was produced, which not only showed the same untarnishable properties as the nickel-chrome alloy, but possessed much greater hardness. The alloy could not be worked to any extent cold, but was found to be malleable at a bright orange heat. It was not until 1906 that the alloy was produced in sufficient quantity to determine its properties fully. In 1909, a cutting blade was made of the alloy, which took an edge comparable to that of tempered steel.

Later, tungsten or molybdenum was added, and the alloy thus produced was sufficiently hard to turn iron and steel on the lathe. Such alloys when properly formed will scratch any steel, and stand up under much higher speeds on the lathe than the best high-speed steel tools. This gives the cobalt-chromium-tungsten alloy termed stellite a field of its own, and places it in a class by itself as a material for high-speed tools.

Generally speaking, the cobalt-chromium alloys possess three distinctive properties, namely:

1. They are untarnishable under all atmospheric conditions, and immune to nearly all chemical reagents.
2. They possess great hardness.
3. They retain their hardness up to visible redness.

Some of the stellite articles for ordinary use are formed from alloys of cobalt and chromium only. This alloy answers well for table-knives, spoons, etc. The harder-edged tools, such as pocket-knives, surgical instruments, etc., contain in addition to cobalt and chromium a certain amount of tungsten to give them greater hardness, while in other instances a certain amount of iron is introduced into the alloy to soften it so that it may be more readily worked. Such articles include table-knife blades, pocket-knife handles, certain dental instruments, etc. When iron is added to the alloy, the resulting mixture is termed 'festel metal', from the chemical symbol for iron (Fe) and the first syllable of stellite.

This beautiful and easily workable alloy is well adapted to the manufacture of fine door-latches, door-knobs, and high-class sanitary fittings for bath-rooms and lavatories. It is not malleable except at a bright red heat, but when a certain amount of nickel is added, it may be worked cold on the lathe or under the file. It can be given a stippled surface resembling that of frosted silver, and retains its lustre in a satisfactory manner.

Some of the later stellite alloys have shown remarkable resistance to chemical reagents. One of these, high in chromium, takes a polish resembling burnished silver. This alloy retains its lustre in boiling aqua regia, and is not affected by immersion in that liquid for 14 days. It is attacked slowly by cold hydrochloric acid, but is practically immune to cold strong sulphuric acid, and nearly immune to the same acid in the diluted form. It is immune to nitric acid of all strengths.

In order to be immune to corrosion, chrome-steels must contain more than 8% chromium. For certain purposes they may contain much more than that amount, even up to 60%. Such steels are distinctly workable and useful, whether subjected to heat-treatment or not.

Numerous metals may be added to stainless or rustless steel, and some of these may contribute slight benefit, while others may be slightly detrimental. Among these are nickel, cobalt, vanadium, silicon, boron, tungsten, molybdenum, titanium, and tantalum. It is evident that an indefinite number of alloys could be thus formed, some with and some without the above elements, but none would be stainless unless it contained the proper amount of chromium, which is the essential element to be added to nickel, cobalt, or iron to produce a stainless alloy.

Stainless or rustless steel consists essentially of an alloy of iron and chromium, containing usually from 0.1 to 1% of carbon, though the latter element may be present up to nearly 2% without interfering seriously with the working qualities of the steel.

Because of the high proportion of chromium and its tendency to oxidize at the melting-point, even in the presence of carbon, the steel is melted either in crucibles or in the electric furnace. After melting, the metal may be poured into ingot-molds in the usual manner, and the ingots thus obtained may be forged or rolled into bars or sheets. If the ingots are small, they will be hard after casting, especially if they have been stripped hot and allowed to cool rather rapidly in the air. Indeed, small bars thus produced are likely to be almost file-hard.

Cold-chisels cast in iron or graphite ingot-molds are sufficiently hard, without tempering, to cut ordinary iron or steel. By heating cast bars to a bright orange temperature, they can be forged readily into various forms. After the forging is completed, the metal may be allowed to cool in the air, and will be found to possess remarkably fine grain and good cutting qualities.

Quenching in water increases the hardness to a considerable degree, particularly if the steel contains more than 0.4% carbon. It is best, however, to use oil for

*From paper presented before the Engineers Society of western Pennsylvania.

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quenching, in order to avoid local contraction-stresses in the finished article, which might cause it to break under slight shock or jar.

Notwithstanding the comparatively high temperature of working this steel, the bars show almost no scale during the forging operation and when finished are covered with a blue-black 'skin' consisting of a thin film of oxide.

Owing to the absence of deep oxidation and resistance to deformation at comparatively high temperatures, the alloy is admirably suited for casting engine-valves and distilling-apparatus, and for many other purposes of like nature. When ground and polished, the alloy resists tarnishing to a remarkable degree. It is superior in this respect to brass, copper, and nickel plate, and far superior to any other steel yet produced.

Devices for Handling Parts to be Heat Treated

In a paper entitled 'Results of Investigations Pertaining to Heat Treating', appearing in the 'Journal' of the American Steel Treaters' Society, Frederick J. Griffiths discusses, among other subjects, the proper handling of parts during heat treating, saying, in part, as follows:

The proper heat treatment of many irregularly shaped pieces depends largely upon the way they are handled after the proper temperatures have been applied for a sufficient length of time. It is well for a hardener to study the proper handling of every new shape to be heat treated, and in this way much scrap due to warpage and breakage can be eliminated. Small gears can be usually successfully handled by quenching along the axis of the hole. Flat gears of small face and considerable diameter will usually warp less when quenched perpendicular to the axis of the hole. By having dies that firmly grasp the web of the gear and are so constructed that proper oil circulation is obtained, machine-quenching has been successfully used on many gears, which were warped beyond possibility of straightening by other methods of quenching.

Straight shafts should be quenched parallel to the axis. When of considerable length they can be kept straight by rolling into and through the quenching medium by a series of screens or guides. Small saws such as screw-slotting saws can easily be kept straight in hardening by clamping them between two internally water-cooled cast-iron disks. Leaf-springs are hardened by placing the straight hot leaf between curved dies, which come together, shaping the spring, and then running in the quenching medium. Bolts, valves, universal-joint bows and similar small parts can be hardened in quantity by making sheet-metal retainers through which holes are drilled to receive the parts. The loaded retainer is inserted in the furnace and brought up to heat and quenched. Small parts are often laid in sheet-metal pans and heated and quenched. Special-shaped tongs are useful in handling gears. The tongs are so constructed that the jaws open when the handles are pressed together, enabling the handling of gears by expanding in the hole, thus eliminating strains caused by unequal cooling at the contact-point of the tongs.

When low furnaces are used, having the hearth of the furnace on the floor-level or level with a small platform, a device consisting of a flat plate mounted on two wheels and equipped with a long handle can be used advantageously for charging and discharging the furnace. This device will handle carbonizing-boxes, automobile front-axles, heavy forgings, and the like equally well.

A considerable number of parts used in construction today require that certain sections be left softer than others, either because a cotter-pin or taper-pin hole is to be drilled in the part after assembling, or to avoid chipping and cracking of threads, or else to give the section a greater amount of ductility in order to resist shock at that one point. Threads on shafts can usually be protected by slipping on a loose nut before hardening. In rivet-sets, when it is desirable to have the centre section ductile to resist shock and the shank and cup hard to resist wear, a simple jig-fixture can be made covering the part to be left soft. By tapering the edges of the jig a sharp line of demarcation of hard and soft sections can be avoided. Designs of this kind easily suggest themselves to hardeners for the particular shape they may have to treat.

Manganese Production Greatly Reduced

A statement recently issued by the U. S. Geological Survey shows the extent of the decline in production of manganese in the United States following the Armistice. While the production of ore for 1918 amounted to 1,450,000 tons, of which 305,000 tons contained 35% or more of manganese, less than 150,000 tons was produced during the last quarter of 1919, of which only 4000 tons contained 35% or more of manganese. Nearly all the higher-grade ore came from Montana, while of the lower-grade 120,000 tons came from Minnesota and 18,000 tons from Nevada. Ore imports during 1919 amounted to 333,000 tons of which 246,000 tons came from Brazil. Stocks of manganese held in this country are growing smaller and an increase in imports is to be expected before long.

Sir Harry Lauder golfs with more enthusiasm than skill, and one day on the links in Washington he was in unusually bad form.

At the fourth hole Sir Harry dislodged an unusually large sod. The sod rose up in the air and sailed like a great bird down the wind, and Sir Harry's caddy, watching it, said to his companion:

"Did you tell me that guy was an actor, Pete?"

"Sure, Bill," said the other caddy, a note of apology in his voice. "An actor, that's what they call him."

The first caddy took a thoughtful chew of tobacco.

"I'd call him a scene shifter," he said.

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Aluminum Castings

In a paper presented before the American Society of Mechanical Engineers, Zay Jeffries, director of the research laboratory of the Aluminum Castings Co., of Cleveland, stated that aluminum castings may be divided into three classes according to the method of manufacture, namely, sand-castings, permanent-mold castings, and pressure die-castings.

Aluminum sand-castings have been regularly made weighing as high as 480 lb. each, but one from 150 to 200 lb. is usually considered a large casting. The minimum weight may be taken as 1 oz., but neither this weight nor 480 lb. should be considered as an extreme limit. In the permanent-mold process the maximum weight is about 20 lb. and the minimum weight about 1 oz. Permanent-mold castings have been made weighing as high as 150 lb. but these large castings should be considered as special.

On gas-engine oil-pans the walls should be $\frac{3}{16}$ in. or more thick and on crank-cases a wall-thickness of 7/32 in. or greater is common practice. Fillets should have large radii, especially where heavy sections join thin ones. The best thickness for pipes, manifolds, and similar articles, is $\frac{1}{8}$ to $\frac{5}{32}$ in. The minimum thickness for permanent-mold castings is 3/32 to $\frac{1}{8}$ inch.

For large sand-castings $\frac{1}{8}$ in. should be allowed for finish and on bench-work $\frac{1}{16}$ in. A finish of $\frac{1}{32}$ in. should be allowed for disk-grinding. The finish on permanent-mold castings up to 3 in. diam., for example, pistons, should be about 0.075 in. on the diameter, and the finish on the piston-head should be 0.045 in. The finish on permanent-mold pistons over 3 in. diam. should be about 0.093 inch.

For sand-castings a tolerance of $\frac{1}{32}$ in. thickness should be allowed and for permanent-mold castings the tolerances are plus or minus 0.010 in. The weight-tolerances for sand-castings using metal-pattern equipment are plus or minus 3% and with wood patterns plus or minus 5%. The weight tolerances on permanent-mold castings are plus or minus 2%.

For roughing-cuts, speeds of 500 to 700 ft. per minute and feeds of $\frac{1}{16}$ in. to $\frac{5}{32}$ in., according to the nature of the work, are recommended. No lubrication is needed for roughing. For extra-fine finish a speed of about 125 ft. per minute is recommended, but speeds up to 600 ft. can be used and satisfactory finish obtained. For turning, the finishing-feeds should be from 0.01 in. to 0.125 in., and for planing up to 0.25 in. A good lubrication-mixture for finishing is 70 parts kerosene and 30 parts lard-oil.

As an engineering metal, aluminum is in a class by itself because of its low specific gravity. Its use is determined by many factors, among which are the following:

Where lightness is of prime importance, aluminum in sheet form has about seven times the stiffness of steel for equal weights. For a given rigidity in any metal structure, aluminum will weigh less than any other metal used in engineering. For such parts, therefore, as aeroplane-engine crank-cases, cam-shaft housings, oil-pans, etc., where lightness and rigidity are of prime importance, aluminum alloys find extensive use.

In the manufacture of gas-engine crank-cases aluminum castings can be machined about three times as rapidly as cast-iron parts, and consequently the first cost of plant installation and labor cost of machining is greatly decreased by the substitution of aluminum for cast-iron. The lightness of the crank-case is the chief advantage because the weight of the engine per horse-power is reduced.

Where the lightness of reciprocating parts, such as pistons, is of great moment, as in high-speed gas-engines, the use of aluminum is beneficial. The aluminum piston also has the advantage of high heat-conductivity, which is sometimes of greater importance in a gas-engine than reduction in weight.

For reducing unsprung weight in motor vehicles, aluminum is particularly valuable. This includes such parts as differential-carriers, rear-axle housings, brake-shoes, hub-caps, and wheels.

Aluminum alloys, especially with moderate pressures, function nicely as bearings against hardened steel. As an example, the Liberty engine cam-shaft was run in aluminum bearings, as were also the rocker-arms. Aluminum alloys, however, do not bear well against soft steel.

For equal volumes aluminum is cheaper than brass or bronze. Aluminum alloys find extensive use as a substitute for brass and bronze castings where freedom from atmospheric corrosion is of prime importance and where the strength requirements are not too severe.

For aluminum castings not highly stressed, No. 12 alloy, consisting of 92% aluminum and 8% copper, should be used. Where freedom from leaks is the main requirement, the 12% copper alloy is recommended. The more ductile zinc alloy should be used for highly stressed parts. Ductility is essential if an alloy is to stand abuse, and this is the main reason for the use of the aluminum alloy containing 2.75% copper, 1.5% iron, and 7% zinc.

Mrs. Anderson rushed into her husband's office, wild with excitement. "Oh, Joe," she cried, "Emma made a mistake and tried to start the fire with gasoline."

"Gasoline, eh," said Joe calmly. "Did she get it started?"

"Get it started," cried Mrs. Anderson. "Why, it blew her out of the window."

"Oh, well," remarked the philosophic Joe, "it was her afternoon out, anyhow."—Edinburgh Scotsman.

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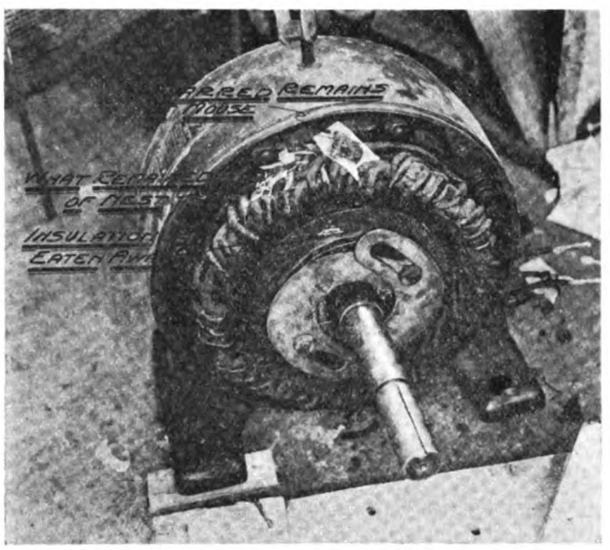
Mouse Causes Damage to Motor

By E. W. CUMMINGS*

The accompanying photograph is almost self-explanatory, but the further statement might be made that the motor develops 20 hp., and is direct-connected to the centrifugal pump controlling a hydraulic elevator. The motor burnt out early Monday morning, showing that



MOTOR AND MOUSE'S NEST

the mouse built its nest some time between the previous Saturday noon and Monday morning. The eating of the insulation off the wires is plainly shown in the photograph. This caused such heat as to burn out the rotor, which, of course, rendered the whole machine useless. The cost of repairs will be between $275 and $300.

A MOTORIST traveling through the White mountains last summer stopped at a country hotel in New Hampshire. While waiting for dinner to be served he strolled into the parlor. In a conspicuous place was a sign:

"Ici on parle Francais."

The motorist looked at the sign and turning to the proprietor, who had followed him into the parlor, asked:

"Do you speak French?"

"Not me," replied the man. "United States is plenty good enough for me, sir."

"Why, then," queried the motorist, "do you have that inscription on your wall?"

"What's that got to do with my speaking French?" asked the proprietor.

"Why, it means 'French is spoken here'," explained the tourist.

"You don't tell me!" cried the hotel proprietor, excitedly. "Well, I'll be darned! I bought that sign of a young man who said it meant 'God bless our home'."—'The Earth Mover.'

*Plant and Safety Engineer, Holt Manufacturing Company.

Safety-Codes to be Framed by the American Engineering Standards Committee

Definite arrangements have been made for the formulation of a considerable number of safety-codes under the auspices and rules of procedure of the American Engineering Standards Committee. The subjects of the codes for which arrangements have been completed, together with the organizations which have been designated by the Committee to act as sponsors, and who have accepted such responsibility, are as follows:

Abrasive wheels: The Grinding-Wheel Manufacturers of the United States and Canada, and the International Association of Industrial Accident Boards and Commissions.

Explosives: The Institute of Makers of Explosives.

Foundries: The American Foundrymen's Association and the National Founders Association.

Gas Safety Code: The U. S. Bureau of Standards and the American Gas Association.

Head and Eye Protection: The U. S. Bureau of Standards.

Paper and Pulp Mills: The National Safety Council.

Power-Presses: The National Safety Council.

Pressure-Vessels, non-fired: The American Society of Mechanical Engineers.

Refrigeration, mechanical: The American Society of Refrigerating Engineers.

Woodworking Machinery: The International Association of Industrial Accident Boards and Commissions and the National Workmen's Compensation Service Bureau.

A number of additional codes are under consideration. A large representative advisory committee of specialists, organized by the National Safety Council, the National Workmen's Compensation Service Bureau, and the Bureau of Standards, at the request of the Committee, to act as its advisor, is actively working on the question of what additional codes are most urgently required and what organizations are in the best position to undertake sponsorship for such codes as may be found to be required.

Standardization of Ball-Bearings

At the request of the Swiss Standards Association, Baden, Switzerland, for co-operation in the work of standardization of ball-bearings, the American Engineering Standards Committee requested the American Society of Mechanical Engineers and the Society of Automotive Engineers to act as joint sponsors for the project. These societies have accepted the responsibility and are now organizing a Sectional Committee for the work. The Sectional Committee will be representative of all the interests involved and is the body which will be responsible for the work of detailed formulation of the standards.

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Comparison of Brands of High-Speed Tool-Steels

In a series of articles recently appearing in 'Chemical and Metallurgical Engineering', A. J. Langhammer describes a comparative test made upon 16 leading brands of high-speed steel. The work was machining Liberty aeroplane-motor cylinders in an 8-in. Lo-Swing lathe. These cylinders are forged from steel tubing of the analysis known as Society of Automotive Engineers No. 1045, which calls for carbon between 0.40% and 0.50%, with 0.45% preferred, manganese 0.50% to 0.80%, with 0.65% preferred, and a maximum of 0.045% for phosphorus and 0.05% for sulphur. The forgings were treated by quenching in oil or water at 1500° to 1550°F. and drawing at 1150° to 1200°F. A uniform cutting-speed of 35 ft. per minute was used, and a uniform depth of cut of 5/32 in. The other conditions of the test were arranged so that of the 12 elements listed by F. W. Taylor as affecting the cutting-speed of tools, only the chemical composition and heat treatment of the tool-steel used and the duration of cut were variable.

The 16 brands of tool-steel tested varied considerably as regards analysis. Carbon ranged from 0.38% to 0.79%; tungsten from 12.8% to 21.92%; vanadium from 0.05% to 2.20%; chromium from 2.42% to 5.27%; nickel from none to 0.24%. None of the brands contained either cobalt or molybdenum, and only a few contained uranium, the maximum being 0.15%. All the tools were preheated slowly to 1550° to 1600°F. The hardening furnace was kept at 2300°F. Oil, lead, or kerosene, or combinations of these mediums, were used for quenching. The drawing temperatures ranged from 1050° to 1100°F. according to the brand.

While the tests showed that several steels of good chemical composition and microstructure failed to give good service because of poor methods of manufacture, Mr. Langhammer recommends the following limits for the composition of the best high-speed steel, which may be compared with the original recommendations made by Taylor in 'The Art of Cutting Metals', fifteen years ago; carbon, 0.62 to 0.68%, Taylor, 0.67%; tungsten, 17.00 to 18.20%, Taylor, 18%; vanadium, 0.85 to 1.05%, Taylor, 0.29%; chromium, 3.00 to 4.50%, Taylor, 5.50%; silicon, 0.20 to 0.30%, Taylor, 0.04%. Mr. Langhammer places an upper limit of 0.04% on both phosphorus and sulphur, while Taylor's specifications simply say that these impurities should be low. Taylor specified 0.11% manganese while Mr. Langhammer prefers none at all.

Another interesting fact shown by the tests is that when a tool is not forced or put to heavy duty, a mediocre steel may show almost as well as a good brand. As the average plant seldom exacts heavy duty from the high-speed tools used, an inferior brand frequently gives satisfactory results in practice. Some of the other conclusions given by the author are as follows:

1. To get the greatest efficiency from high-speed steel tools, they must be operated under heavy duty, and no tests are reliable unless made with heavy cuts.

2. Test-tools must be re-ground once, at least, and then again put through a run.

3. High-speed steel should be purchased only on the basis of performance.

4. A wide variation exists in the cutting qualities of the various brands of high-speed steel on the market today, and both indirect and direct costs are affected adversely when inferior steels are used.

5. Heat-treating practices of today leave wide room for improvement.

6. In hardening, the time factor is probably the important item needing investigation.

7. It is expected that a method of determining the efficiency of high-speed steel by means other than the service cutting-test will be developed. Work with the X-ray and the magnetic properties gives promise of good results in the future.

Some investigators have apparently concluded that a cutting-test consisting of running a tool to destruction by 'turning off the face' (that is, using the cross-feed and not longitudinal feed) of a bar yields accurate results. This, the author holds, is erroneous. In the first place, at least two variables are introduced, namely, cutting-speed and material cut. The cutting-speed varies so that at the centre of the bar the duty is low, while near the outside, it is high. If a tool approaches its breaking-down point while cutting anywhere near the periphery, failure occurs at once. If, on the other hand, a tool near the point of failure manages to survive a cut at the outside of the bar, it will continue to cut on its next travel out from the centre until a high cutting-speed is reached, when it will fail suddenly. However, had the previous cut been continued for only a short time longer, failure would have occurred. The result of such a testing practice might easily be a wide variation in performance in tools actually of the same quality. Variations in the material cut will usually also be encountered.

While the owner of the small shop will not usually be in a position to make as comprehensive a test of tool-steels as the larger concern, nevertheless, he should be able by careful study of his needs to select a few brands and to test these according to approved methods. Every care should be taken to ensure the correct heat treatment, and to avoid possible damage in hardening. As far as the material is concerned, a straight production job will give satisfaction if the necessary precautions are taken. A feed of $\frac{1}{16}$ in. or more, depth of cut $\frac{1}{8}$ in. or greater, time for failure of tools to occur in 20 to 30 minutes, four test-tools per brand, provision for at least one re-grind, and a careful record of all data are the essential requirements.

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Effect of Sulphur and Phosphorus on Steel

In a paper by E. E. Thum read before the New York Chapter of the American Steel Treaters' Society, and published in the May issue of the 'Journal' of the Society, the effect of sulphur and phosphorus on steel is discussed with special reference to the investigation of this subject now being made by the U. S. Bureau of Standards and the American Society for Testing Materials in co-operation with other interested organizations. Mr. Thum's paper is fairly exhaustive and summarizes the principal data, both theoretical and experimental, available upon the subject.

Regarding sulphur, the consensus of opinion is that any sulphur present must certainly be counteracted by a liberal quantity of manganese in order that excessive fragility in the cold metal may be avoided. On the other hand, red-shortness cannot be reduced effectively by the addition of manganese. For this reason, steel-makers find it to their own interests to keep the sulphur low in shapes, plates, and forgings. Apparently nearly all the manganese sulphide is gathered into a slag relatively difficult to fuse and having an indefinite composition. The slag, however, is plastic at rolling-temperatures. Even this slag is objectionable in the higher grades of steel.

Phosphorus hardens, strengthens, and makes steel brittle, which effects are intensified by like action on the part of carbon. Unlike carbon, phosphorus has not been studied sufficiently to determine its action under various conditions of manufacture and heat treatment. It exists as a solid solution in ferrite and austenite both hot and cold up to the limits now allowed by accepted specifications, but of all substances known in the iron solid solution, it is probably the slowest diffusing. Consequently the excessive segregation likely and the extreme difficulty of distributing these concentrations make it necessary that the average analysis be low in order that the areas of maximum content may not be out of step with the physical properties of the remainder of the metal.

Such information is almost entirely qualitative. When people start talking about the limits allowable, the ease with which they can get low-phosphorus steel has considerable influence.

Furthermore, while nominally sulphur and phosphorus are on trial, the real culprits may be metallurgical conditions of which these two elements are only chance companions. Steels with abnormally high impurities have been made that passed excellent mechanical tests. There are men of the opinion that at bottom the study is not of phosphorus or sulphur limits but rather of good steel-making. We use steel, not on account of the presence or absence of certain chemical elements but on account of the mechanical properties it possesses. We could get along without setting chemical limits if our acceptance-tests were really exhaustive. A great deal of steel is made under specifications that are silent regarding sulphur limits, but which name severe mechanical acceptance-tests. American practice has tended away from completeness of mechanical testing, so that, for example, toughness, ductility, and shock resistance are rarely made objects of commercial acceptance-testing. It seems probable that after complete studies have been made of sulphur and phosphorus, we may, while abandoning some of our traditional faith in chemical limits for steel, revise our conceptions of the most desirable scope of mechanical testing, to the benefit of economy of production and excellence of product.

Organization of the committee in charge of the investigation already mentioned has been effected and three sub-committees appointed. The sub-committee on statistics is headed by H. L. Whittemore, of the Bureau of Standards. It is engaged in visting large manufacturers and users of steel, obtaining information about material high in sulphur and phosphorus, whether it has proved satisfactory or has failed in service, and collecting samples of such material worthy of study. An investigation of the published literature is also under way.

The sub-committee on manufacture, which is headed by G. K. Burgess, of the Bureau of Standards, has submitted a program of tests, and will supervise the manufacture of all metal made for this investigation. Two classes of steel will be studied, one containing moderate amounts of residual impurities, while the other will contain excessive amounts of sulphur or phosphorus added to the metal during a late stage of manufacture. Six groups of the following typical analysis will be studied:

	Carbon, %
Rivets and tubes	0.06–0.12
Plates and shapes	0.16–0.22
Forgings	0.44–0.55
Rails, wheels, and tires	0.65–0.70
Springs	0.95–1.05
Castings	Not stated

When the effect of sulphur is being studied, the phosphorus is to be held as nearly constant as possible and equal to the usual value for that group of materials, and vice versa.

The sub-committee that will supervise the mechanical testing is headed by F. C. Langenberg, of the Watertown Arsenal. In addition to the usual standard tests of the American Society for Testing Materials, various special tests will be made, including, where possible, those for impact and endurance. An endeavor will also be made to determine the amount and types of gases present. The metals under investigation will also be fabricated and observed under normal service. Fabrication tests will include flanging, punching, drifting, cold-pressing, and riveting. Service-tests will also comprise a detailed study of abnormal analysis whose history can be definitely determined, and which has been discarded because of failure or wear.

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Malleable-Iron Castings

In a paper presented before the American Society of Mechanical Engineers, Enrique Touceda called attention to the fact that malleable-iron castings have been produced commercially as long as 5 ft., with sections at some parts as thick as 3 in. In regular practice castings varying in weight from 300 to 500 lb. are made daily, while it would be difficult to place a limit on how small they can be run.

The wearing properties of this metal correspond to what can be expected of wrought-iron or dead-soft steel, while its machining properties can hardly be excelled. As far as the ordinary uses of malleable cast-iron are concerned, no beneficial results can follow from heat treatment. In a limited number of cases, however, such as in the production of cheap hatchets, cleavers, and axes, malleable-iron can be made file-hard by heating just above the critical range and quenching.

A general statement relative to the comparative cost of manufacture of malleable-iron, gray-iron, and steel must obviously involve the consideration of many variable conditions. If it were not for the fact that in the manufacture of malleable-iron, the annealing (which lasts from six to seven days and is a costly part of the process) must be taken into account, an approximate estimate could be made by computing the cost of the metal in the ladle for each of the three products; but the varying cost of molding in each case and the fact that the sprue can be easily knocked off both gray and malleable-iron castings while it must be machined or cut off the steel casting, render it difficult to make a comparison of the costs of the raw castings. In general, however, gray-iron castings are heavier than those made of malleable-iron. Consequently there is less sprue and therefore less remelt. Also there is less variation between the composition of the sprue and that of the charge and as a consequence a much larger proportion of scrap can be used in the mixture when making gray-iron than is possible in the case of the malleable castings. Assuming the highest fuel-ratio in each case, 10 of iron to 1 of coke for the cupola, and 3 of iron to 1 of soft coal in the air-furnace, it will be seen that the cost for fuel is less in the former than in the latter case. The same holds true for furnace maintenance. Aside from cleaning and chipping, the gray-iron casting is finished when the metal fills the mold, while the white-iron castings must be cleaned, taken to the annealing-room, packed in saggars, and then charged into the annealing-oven and heat treated for a period in most instances of seven days. The saggars must then be removed from the annealing-oven, the castings again cleaned and sorted, to the cost of which must be added that of the fuel used for heat treatment, oven maintenance, supervision, and overhead. On an average it will cost 1 cent per pound more to produce malleable-iron than it will gray-iron castings, and at least 30% more to produce steel castings than malleable.

The malleable-iron casting is regularly used and can be recommended in the fabrication of railway-cars, agricultural implements, motor vehicles, tractors, link-belts, chains, fittings, and stoves, and is adapted for use for any part of such size as can be successfully made where strength combined with ductility is a necessity, and low cost per pound an essential qualification of the product.

Design and Arrangement of Furnaces for Heat Treating

In a paper embodying 'Results of Investigations Pertaining to Heat Treating' appearing in the 'Journal' of the American Steel Treaters' Society, Frederick J. Griffiths calls attention to the fact that almost every special class of work requires some modification of the general types of heating furnaces now on the market. When produced in quantities a great many of the smaller parts can be handled cheaply and properly in continuous furnaces. These usually consist of a chamber in which the heat is generated and applied, and a revolving drum, the drum being equipped with an automatic charging and discharging device. Some furnaces are arranged so that the heat is generated directly in the revolving drum. With this type of furnace uniform results may be obtained with little attention and with low production costs.

When produced in quantity crank-shafts, cam-shafts, leaf-springs, axle and propeller shafts as well as connecting-rods can be advantageously handled in flat-hearth continuous furnaces. These are usually constructed with some sort of guides and runners on the hearth in the shape of rails or flat strips. With this type of furnace one or several of the parts to be heat treated are introduced periodically into the furnace with some mechanical device pushing them along the hearth until they are dropped at the other end of the furnace into a quenching medium. These furnaces are usually so constructed as to permit such regulation of temperature as may be required by difference in the analyses of the steels used. The charge-end has usually a low temperature, the furnace gradually becoming hotter toward the end where the proper temperature of quenching is maintained.

In selecting a furnace for special work where quantity production is not possible, it is well to bear the following facts in mind: The furnace should be of the proper size to allow uniform heating of the steel without direct contact with the flame. It is usually safer to use a larger furnace rather than one just large enough to accommodate the work to be handled. For annealing operations of any extent and quality, the car-type furnace probably gives the most satisfactory results considering the amount of time taken in loading and unloading the furnace.

If the furnace is so placed as to allow charging at one end and discharging at the other, two cars may be used permitting the loading or unloading of one while the other is in the furnace.

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Causes of Blowholes, Porosity, and Unsoundness in Aluminum-Alloy Castings

The U. S. Bureau of Mines has recently published Technical Paper 241, 'Blowholes, Porosity, and Unsoundness in Aluminum-Alloy Castings' by Robert J. Anderson, containing a general discussion of this subject and also describing the results of a series of experiments on an alloy composed of 92% aluminum and 8% copper, known to the trade as No. 12, and the most commonly used of any aluminum alloy. The following general conclusions are given:

1. The number of blowholes present depends on the pouring-temperature; the higher the pouring-temperature the greater the number of blowholes and the more unsound is the casting.

2. Unsoundness varies with the temperature to which the charge is heated; the higher the temperature in the furnace the more unsound the resultant castings are, irrespective of the pouring-temperature.

3. Unsoundness varies with the length of time of melting; the longer any melt is held in the furnace the more unsound are the castings, irrespective of the temperature of heating and pouring-temperature.

It can be readily seen that the factors affecting the soundness of castings can influence one another either favorably or adversely. Thus, pouring an overheated melt at a lower temperature by allowing the charge to cool prior to pouring will aid in minimizing the deleterious effects of overheating. Castings poured at low temperatures are more sound than those poured at high temperatures, but heats held in the furnace for a long time at either high or low temperatures are more unsound than those held for a short time. The most aggravated cases of unsoundness will result from pouring a melt at a high temperature which has previously been excessively overheated and for a long time. There is nothing to lead to the belief that, within reasonable limits, there is a minimum temperature below which it is not safe to go for fear of unsound castings from too low a pouring-temperature.

The results of the experimental heats and also past foundry experience, together with the general information available, would lead to the conclusion that, with the methods of melting now in vogue, the heats should be kept at a low temperature in the furnace, melting should be as rapid as possible—that is, the charge should be poured as soon as it is melted—and the pouring-temperature should be as low as is consistent with the metal filling the mold. These conditions can be attained only by close supervision of melting and pouring, together with a study of the appropriate correlation between the molding-floor and the furnace-room. It will be best to have the molding-floor waiting for metal rather than have the furnace-room waiting for the molds. Close pyrometric control is also presupposed in actual foundry production.

Stellite as a Material for Making Gauges

In an article appearing in a recent number of the 'American Machinist', H. L. Van Keuren suggests the use of stellite for making gauges. The fundamental requirements for gauges he lists as follows: wearing qualities, suitable coefficient of expansion, permanency, resistance to corrosion, susceptibility to a high polish, ease of machining, uniformity of material, and hardness.

The wearing qualities of stellite are shown by the fact that it takes five times as long to lap a stellite gauge as it does to lap a gauge made from an alloy-steel particularly well-suited for wear. This indicates that a stellite gauge should wear five times as long as the best of steel gauges.

The principal requirement for the coefficient of expansion of a gauge-material is that it should be as near as possible to that of the metals that are to be gauged, which are usually either iron or steel. This is true of stellite.

Hardened steel sometimes changes dimensions and shape with time, probably because of the relieving of strains set up during the hardening process. Since the hardness of stellite is not the result of a process of heat treatment, it is probable that stellite gauges will show permanency of shape and dimensions. Measurements to extend over a period of years have, however, been commenced on stellite specimens by the U. S. Bureau of Standards in order to determine this point definitely.

Stellite possesses the qualities of resistance to corrosion and susceptibility to a polish in a high degree. On account of hardness, it cannot be machined but must be ground to shape from the rough casting, and this grinding is not easy, because it is non-magnetic, and therefore cannot be held in a magnetic chuck. However, the grinding can be done.

The hardening of steel so as to obtain uniformity in the product is a difficult process, and the fact that the hardness of stellite does not depend upon a process of treatment indicates that it will prove superior to steel in this respect. The last quality on the list, namely, hardness, has already been discussed.

Some experimental gauges of stellite have been made, which gave satisfactory results. Their wearing qualities and resistance to corrosion, in particular, should be sufficiently superior to those of steel gauges as to counterbalance their somewhat greater cost. The welding of stellite tips for machine-tools on ordinary steel shanks suggests that a similar course might be followed with gauges, thus reducing the cost.

"Yes, I still have the first pound-note that I made," said the gray-haired passenger.

"Good gracious!" exclaimed his traveling acquaintance, "how did you keep it so long?"

"Well, it was very imperfect, being my first, and I'd have had trouble in passing it."—'London Weekly Telegraph.'

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Book Reviews

Mechanical Drafting Manual. By Charles B. Howe. Part I. General Principles of Drafting and Working-Drawings. Part II. Geometry of Drawing. John Wiley & Sons, Inc., New York. For sale by 'Mining and Scientific Press'. Price, 50 cents each.

These are evidently for use in the class-room or elsewhere in connection with the author's 'Mechanical Drafting'. They could hardly be used to advantage in any other way. Each 'Part' consists of a heavy envelope containing about fifteen 6 by 8-in. sheets, upon each of which are directions and sketches for the performance of a particular lesson in the subjects indicated by the titles above. This particular form is unusual for an instruction course, but there are certain evident advantages.

Engineering for Land Drainage. By Charles G. Elliott. Pp. 353. Ill., index. John Wiley & Sons, Inc., New York. For sale by 'Mining and Scientific Press'. Price, $2.50.

This is the third edition of a book which, appearing originally in 1902, has come to be regarded as a standard treatise on the subject. Comparing it with the second edition, we find several changes and additions, including a revision of the discussion of the hydraulics of flow in underdrains, new tables for computing the discharge of tile-drains, and additions to the discussion of drainage by pumps and of drainage of irrigated lands. The book covers both the engineering and administration of the drainage of both large and small areas, whether by private, co-operative, or public enterprise. Like the earlier editions, it will be needed by the drainage engineer.

Hydrology. By Daniel W. Mead. Pp. 626. Ill., index. McGraw-Hill Book Co., Inc., New York. For sale by 'Mining and Scientific Press'. Price, $5.

In this volume, Professor Mead has increased the debt that the hydraulic engineers of America, and for that matter of the whole world, owe to him. Every aspect of the subject is discussed thoroughly and each chapter closes with a reasonably complete bibliography for the use of the engineer that wishes to pursue his studies further. The various meteorological factors affecting rainfall are discussed in turn, and this is followed by a consideration of the factors affecting runoff, with particular attention to the conditions producing floods on the one hand or drought on the other. The book is well-illustrated with photographs, maps, and diagrams. It will prove indispensable to the hydraulic engineer.

The New Industrial Unrest. By Ray Stannard Baker. Pp. 231. Doubleday, Page & Co., Garden City, New York. For sale by 'Mining and Scientific Press.' Price, $2.

The author of this book is well known to the reader of popular magazines because of his articles on both industrial and political matters. He approaches the field of industry from the standpoint of an outside investigator, but, nevertheless, an investigator who is honestly desirous of learning the truth and of being fair to both sides. The first few chapters are devoted mainly to the steel strike. While admitting the excellence of the welfare work done by the U. S. Steel Corporation, and the sincerity and good intentions of the officials both before and during the strike, he holds that the Corporation is an industrial autocracy, and considers Judge Gary as typical of the ultra-conservative employer. Both employers and workingmen he divides into three general classes: conservatives, moderates, and radicals, and considers that the moderates in both groups are still in the majority. He discusses various solutions offered by the two sides for the problem of unrest, and places his own approval on some form of works-council system. In particular he discusses the application of this system to the men's clothing industry. Considerable space is also devoted to employment management as a means of helping in obtaining better industrial relations. In the endeavor to be timely and up to date, the author has perhaps erred on the side of too hasty composition, but the book will be read with profit by many people that could not be induced to look at some of the more scholarly studies of industrial relations.

Topographic Maps and Sketch Mapping. By J. K. Finch. Pp. 170, ill., index. John Wiley & Sons, Inc., New York. For sale by 'Mining and Scientific Press'. Price, $2.50.

Interest in maps, and particularly topographic maps, has been stimulated, like interest in so many other subjects, by the War. The treatment in the present volume is non-technical and can be followed readily by the layman who has only the most elementary knowledge of mathematics. The book will be useful principally to two general classes of readers; first, men and women that use topographic maps but who do not know how to get the maximum benefit from them, and second, students engaged in learning to make a map that will be of maximum benefit to the user. The book is therefore appropriately divided into two main parts, Map Reading, and Sketch Mapping, besides a short additional chapter on Landscape Sketching. The discussion of map reading covers three chapters entitled, respectively, What a Topographic Map Shows, How to Get Certain Information from a Map, and Use of Topographic Maps in the Field. Part II, on Sketch Mapping, is similarly divided into Topographic Drafting, Flat Mapping, and Contour Mapping. The appendix contains a descriptive list of the principal topographic maps of the world, suggestions for a course in map reading and sketch mapping, and a bibliography, the first of the three divisions being particularly valuable.

Employment Psychology. By Henry C. Link. Pp. 435. Ill., index. The Macmillian Co., New York. For sale by 'Mining and Scientific Press'. Price, $2.50.

The psychologist just now is receiving the attention in the industrial world that was given to the efficiency expert a few years ago. Both have suffered because of the men that, after acquiring a smattering, posed as experts, and have suffered also because part, at least, of the general public has expected entirely too much from their work. If any reader of the present volume expects unduly important results from the work of the psychologist, it will not be the fault of the author, who is ever on the alert to point out the limitations of psychological methods not only in the hands of a novice, but even when used by an expert. On the other hand, he shows that carefully selected psychological tests and records can be made of great value, not only in hiring employees, but also in transferring, and even in 'firing', when that becomes necessary. The material in the book is based mainly on actual experience with the workers in industrial concerns. Part I is devoted to psychological tests, describing the tests used, and the results obtained in selecting both men and women for various kinds of factory and office work. Special stress is laid on the importance of suiting the test to the particular kind. In discussing the scope of psychological tests, the author gives his reasons for believing that tests cannot be developed that will be of service in selecting men for the higher executive positions. Part II deals with trade tests and other applications of employment psychology, and considers such subjects as the proper methods to be used by an employment manager in questioning an applicant, the analysis of jobs, and the field of the so-called vestibule school. Part III discusses selection and retention of employees, while Part IV gives the author's general conclusions regarding the application of psychology to employment problems, considered from the point of view of both the employer and the employee.

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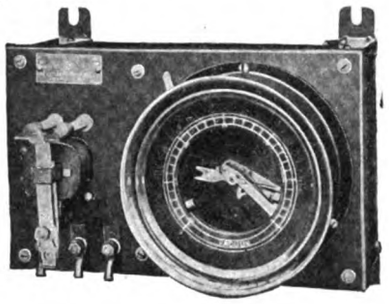
INDUSTRIAL EQUIPMENT

NEW REGULATOR FOR MOTOR ON PRESSURE SYSTEMS

A new gauge-type pressure regulator is being manufactured by the Cutler-Hammer Mfg. Co. of Milwaukee to replace former apparatus. The new regulator consists of a pressure gauge and relay mounted on a slate panel carried on a wall-type frame, and may be used on either A.C. or D.C. circuits. It is more durable and cheaper than their former types of regulators, the manufacturer claims.

This device is used as an automatic means of controlling the pilot circuits of automatic starters used with motors operating pumps, compressors, etc., and can be used on pressure systems above or below that of the atmosphere. As the pressure falls or rises the needle indicator in the pressure-gauge makes contact with one of two adjustable contact points, thereby starting or stopping the motor when the pressure falls or rises to the points at which the contacts are set. The two contact points can be set as close as



5 % of the total reading shown on the gauge, and give practical results, and can be made accessible for adjustment by unscrewing the glass cover of the dial. The pressure inlet hole in the gauge-cover is tapped for ⅛-in. pipe. The gauge can be supplied with dials reading in various capacities, the smallest being 0 to 25, and the largest 0 to 10,000, all readings being in pounds per square inch. Dials reading from 0 to 30 in. of mercury below atmospheric pressure can also be provided.

The relay used in connection with the gauge has solid copper contacts, and will operate on either direct or alternating circuits. The relay provides low-voltage release, and will operate to start the motor when the voltage returns. Pressure regulators of this type must always be mounted in a vertical position and should be connected to an independent pipe from the pressure-tank, or else to the discharge line from the pump with an air-chamber interposed between to prevent the fluctuation in pressure produced at each stroke of the pump from seriously affecting the gauge needle.

DESIGN OF FIXTURES FOR REPETITION WORK

The average manufacturer with a well-equipped toolroom in his own plant is likely to believe that he can have fixtures made in his toolroom that will be better suited to his needs than could be furnished by any outside concern. This is probably true of ordinary work on general purpose machine-tools. However, volume of orders in many industries has become so great that the purchase of a machine-tool to perform one special operation or set of operations during its life has become common, and only under such conditions is the attainment of the maximum economy of quantity production possible. As a result of this development, certain machine-tool manufacturers, rather than build up a standard line of tools that a customer would have to adapt to his special requirements, have devoted themselves to the production of tools that give each customer the production he requires on the particular part.

The experience gained by a company of this kind in the design of special machines and fixtures and the necessary frequent consultations with various production engineers

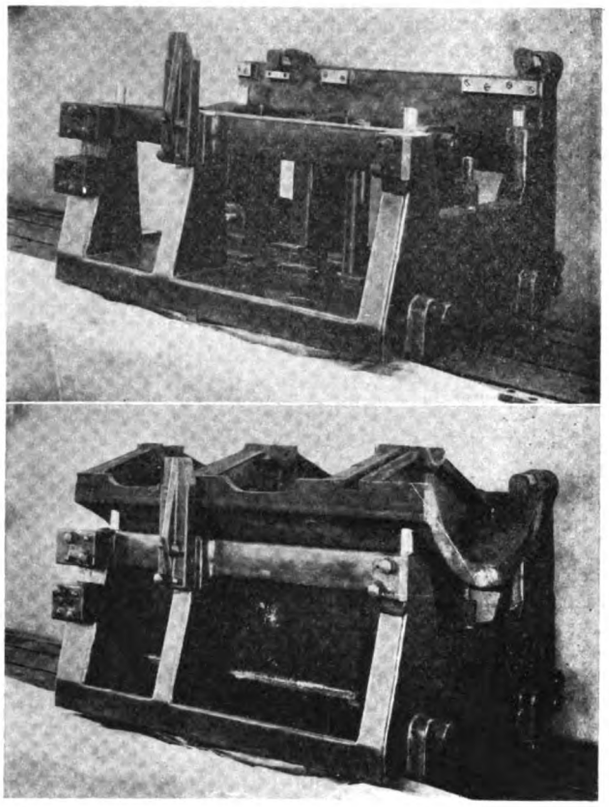


Fig. 1

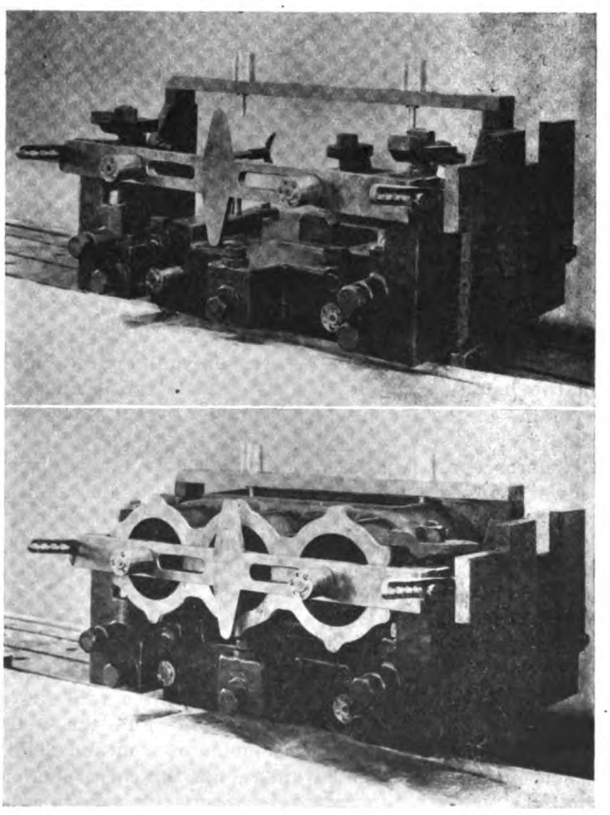


Fig. 2

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throughout the country place it in a better position to give assistance in designing special fixtures than the company for which the fixtures are being designed.

In the accompanying illustrations, Fig. 1 shows a fixture designed by the Ingersoll Milling Machine Co. for use on one of its machines for milling a four-cylinder tractor-motor block. The casting is milled on both ends with regular face-mills, while in the same pass, arbor-mills straddle the bearings and machine the ends of each bearing. Cutter-setting plates are shown on the near side of the fixture.

In Fig. 2 is shown another fixture designed by the company for milling a closed-head cylinder-block. The casting is located by means of spring-feeler target-gauges set on the top and near side of the fixture. The bars are removed after the casting is clamped securely and before starting the feed. In this operation the surfaces milled are the crank-case contact-surface, the hand-hole plate-surface, and the manifold surface. Cutter-setting gauges are shown at the right-hand end of the fixture.

GRINDING-WHEEL HARDNESS VERSUS METAL HARDNESS*

By H. W. Wagner

Hardness of metals and hardness (denoting grade) of grinding-wheels have separate meanings.

A metal is said to be hard when it resists penetration by a point or a tool. The same term as applied to grinding-wheels refers to the strength of the bond that holds the abrasive grains together, without reference to the hardness of the abrasive.

Several methods are practised to determine the hardness of materials. One cannot accurately describe this property of a tool-lathe, for instance, unless he specifies the means by which the hardness was measured. Six general methods are listed here.

1. Scratching. When a point of one material will scratch surface of another, and when the converse is not true, the first material is said to be the harder. The Mohs scale has 10 minerals as standards. Diamonds, the hardest, is 10; sapphire is 9; while the gap between the two is wide. A jack-knife blade comes between 6 and 7 on this scale. Results of this test cannot be translated into figures sufficiently accurate to make it valuable for the metal worker.

2. Filing. The experienced tool-maker can tell the relative hardness of different pieces of steel by trying a hand-file on them.

3. Drilling. The cutting hardness of soft metals can be determined by the Bauer method. The hardness-numeral assigned to the metal tested depends upon the depth of hole drilled for a certain number of turns of the drill fed by a constant pressure.

4. Indentation by a steel punch. The Martel hardness-numeral depends upon the weight of the pointed punch, upon the height of its fall to the metal tested, and upon the volume of the indentation it makes. This is a French method.

5. Scleroscope. A light hammer with a diamond set in its lower end dropped from a standard height upon the material under test. The scale-height to which the hammer rebounds inside its glass tube is then noted.

6. Brinell. A hardened steel ball is forced, under a heavy constant pressure, against the surface of the test-specimen. The hardness-numeral is then figured from the diameter of the impression left by the ball, or from the depth of penetration while the pressure is applied. One modification of the Brinell method is to substitute a pointed tool for the round ball. Both the Shore scleroscope and the Brinell machine would place certain specimens of iron and steel in the same relative order of hardness; but the correspondence is limited.

Although all six methods purpose to measure 'hardness', there are at least three really different properties of materials involved. The scratch-test would give some indication of the ability of a hardened spindle to resist abrasion. The wearing quality of bearing surfaces, as determined by special testing machines, is more significant, but could not properly be termed hardness. The drill-test and possibly the file-test would indicate the relative ease with which a crank-shaft could be machined. Indentation by a steel punch, and the scleroscope and Brinell tests would measure the compression hardness of a steel anvil.

Typical hardness numerals for cast-iron are given for those methods whose results can be converted into significant figures. A higher numeral by any one method would mean a harder material.

	Cast-iron
Bauer drill-test	2.29
Indentation by steel punch	250
Scleroscope	33
Brinell (by diameter)	172

It is unfortunate that no one method is applicable to all engineering materials. A hardened steel that gave a scleroscope record of 73 had a Brinell numeral of 601, indicating great compression-hardness; but glass that gave a scleroscope record of 95 would crush under a fraction of the above Brinell pressure. A rubber eraser gives a scleroscope test of 35, but manganese steel, which is too tough to take the drill-test, gives a test of only 25.

The kind of hardness-test made should, if possible, be governed by the use for which the material is designed; and the man who passes upon the results should know how to interpret them in terms of serviceableness of the material.

Although abrasives possess different degrees of hardness by the scratch-test, and possess different degrees of cutting-temper, the wheel-man considers none of these properties when he speaks of the hardness or grade of a grinding-wheel.

An R wheel is of a harder grade (by the Norton designation) than a Q wheel, by virtue of a greater strength of bond, which holds the abrasive grains together. When a grading tool, similar to a screw-driver, is turned, while the point is forced against the wheel, more force is required to dig grains from the R wheel than from the Q wheel.

While the bond is of the same nature in both wheels, its amount is higher in the harder wheel. Abrasive grains, dulled by grinding, will not be torn out as readily from the R wheel as from the Q wheel, and the first wheel as said to 'act harder'. When wheels are made, a comparatively hard or a comparatively tough abrasive can be put into either the harder or softer wheel.

One peculiar relationship between hardness of work and grade of wheel deserves mention. When the experienced grinding-machine operator goes from soft to hardened steel, he puts on a wheel of softer grade, although he may continue using the same kind of abrasive. There are two reasons why this should be done.

1. The harder steel will dull or glaze an abrasive grain more rapidly than will the softer steel; so a softer grade of wheel, which does not hold its used grains as long, is employed.

2. The hardened steel, being somewhat brittle, is not as tough as the soft steel and has less tendency to pull the worn abrasive grains out bodily.

Hardness of the work being ground determines also to a certain extent the temper, as well as grain-size of the abrasive best suited to that work.

Alundum and crystolon abrasive grains are so much harder and are so much different in other respects than the metals, that it is of little use to compare their hardness-numerals. By the scratch-test, alundum is slightly harder than sapphire (9) on the Mohs scale. Crystolon is appreciably harder than alundum and is also more brittle.

*From 'Grits and Grinds'.

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THE SIMMONS MAGNETIC CHUCK

In the Simmons magnetic chuck, which is manufactured by the Taft-Pierce Co., of Woonsocket, Rhode Island, and which is shown in the accompanying illustrations, the magnetic circuit is a complete unit entirely separate and distinct from the body of the chuck. The circuit is of the multiple-pole type and the face-plate is made of a series of interlocking pole-pieces mounted in position with non-magnetic metal between the adjacent sides and completely surrounding them, the combination being included in a frame, which is attached to, and forms part of, the body of the chuck.

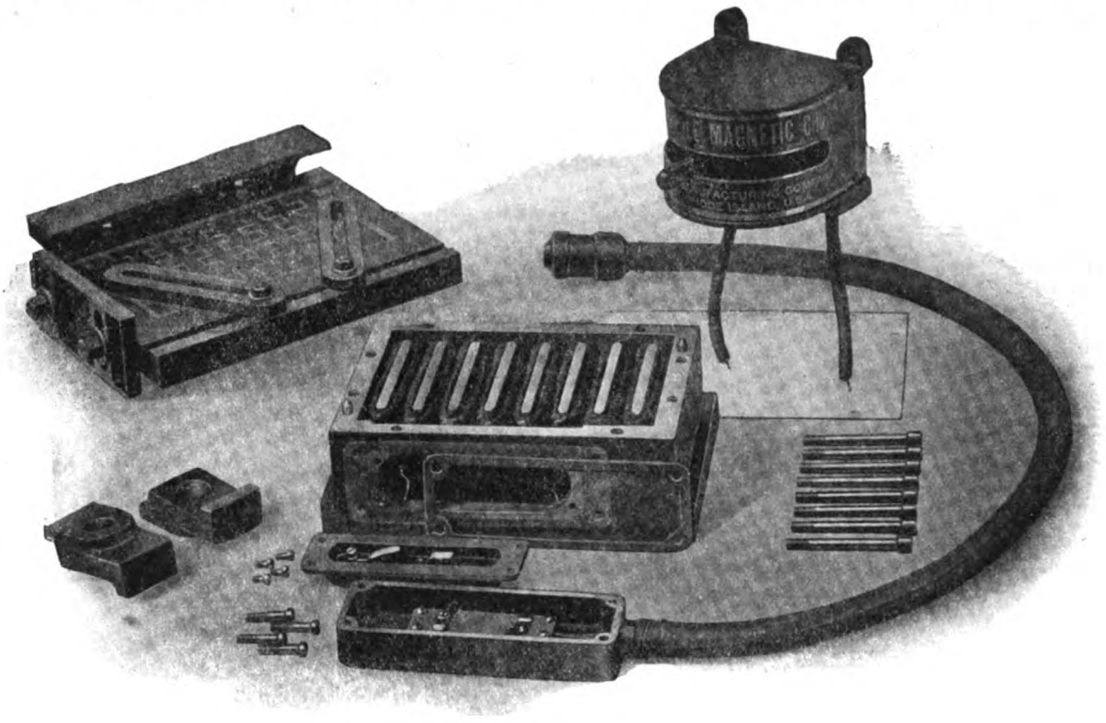

Fig. 1. Disassembled View of Rectangular Chuck

By mounting the magnetic circuit inside the body, and separating the two by non-magnetic material at all points of contact, the magnetism under no circumstances will travel through the body of the chuck, and therefore there can be no leakage from the chuck to the machine or the tools. In fact, the body of the chuck with this type of construction, when of iron, forms an effective barrier for magnetism, so that magnetism from inside the chuck cannot get out, nor magnetism from the outside get into the chuck. On account of the unit construction, the magnetism produced in each pole passes into the adjacent pole-piece, and nowhere

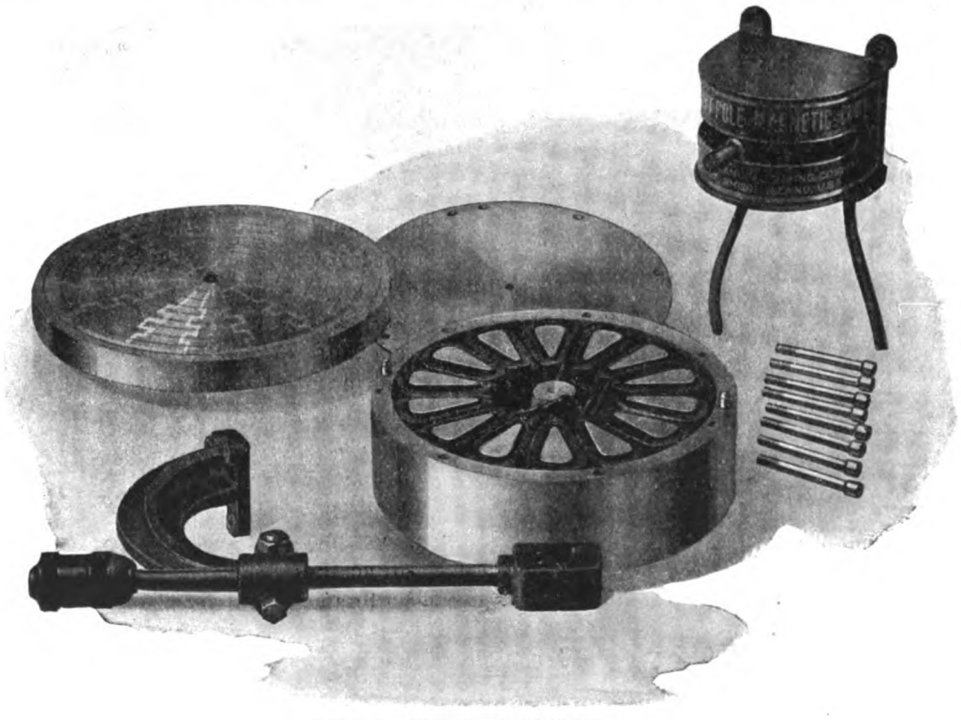

Fig. 2. View of Rotary Chuck

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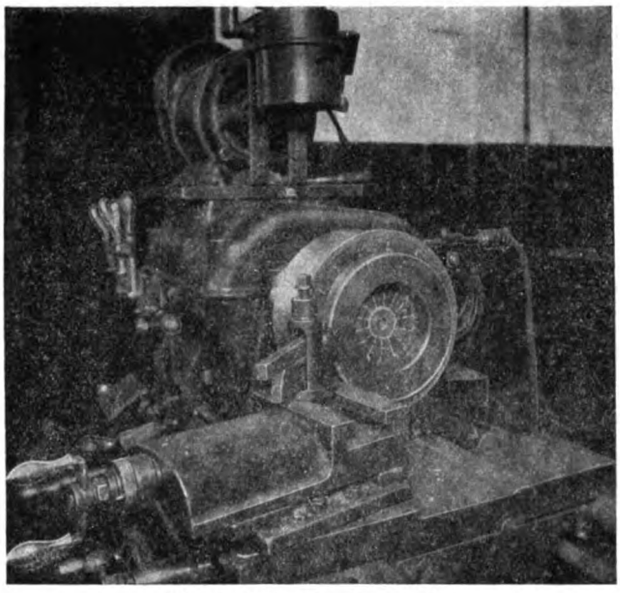

Fig. 3. Rotary Chuck on Lathe

else, which means a short path of maximum area and gives maximum magnetism and pull in a given space.

Fig. 1 shows a complete disassembled view of the 8 by 10-in. T-slot chuck. The magnetic circuit with coils in position is shown in the body of the chuck. The face-plate and terminal blocks have been removed. The switch for controlling the chuck may be placed at any convenient point on or near the machine, leads running from one side of the switch to the supply-line and from the other side to the chuck. All chucks are supplied with a rubber-hose covering for the lead-wires for use in wet-grinding. The back-rest and back-plate can be removed from the face-plate when desired, as can also the end-stop. Both the end-stop and the back-rest are adjustable for height. The terminal box can be removed without disturbing the internal connections of the chuck.

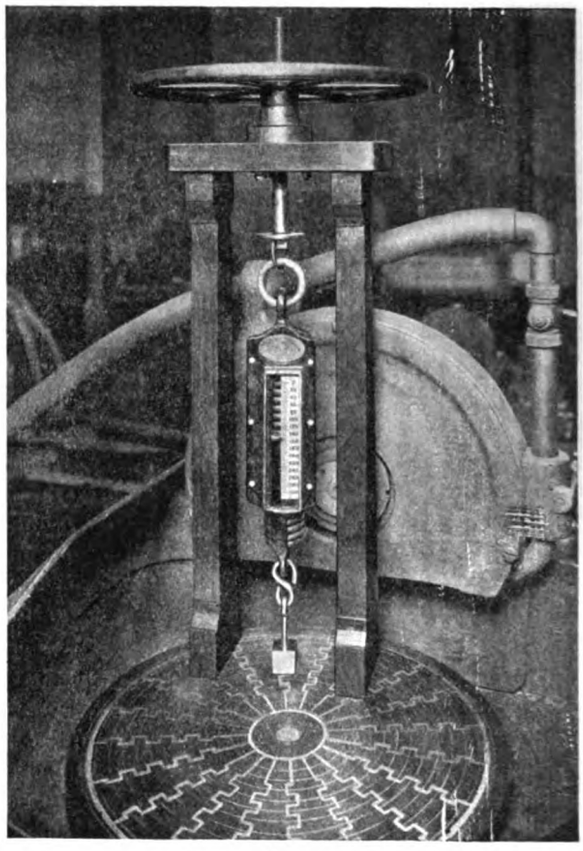

Fig. 5. Holding Power of Chuck Illustrated by Spring-Balance

Fig. 2 shows the 10-in. rotary aluminum-body chuck. The face-plate is attached by long stud-bolts extending through the walls of the body but not penetrating to the interior. The face-plate is held by dowels, and the gasket between it and the body makes the chuck water-tight. There are no holes through the face-plate.

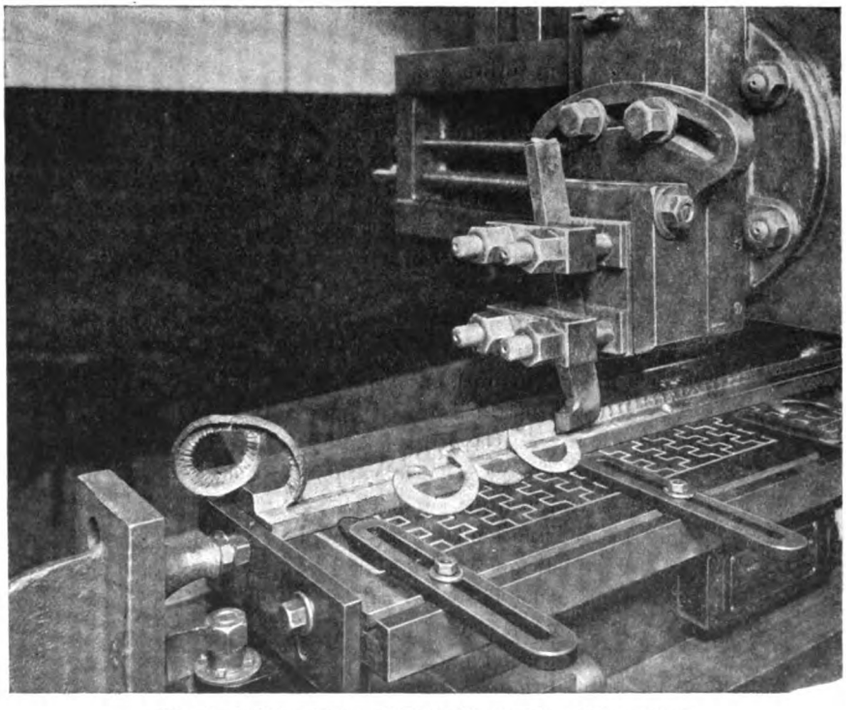

Fig. 6. Holding Power of Chuck Illustrated on Planer Work

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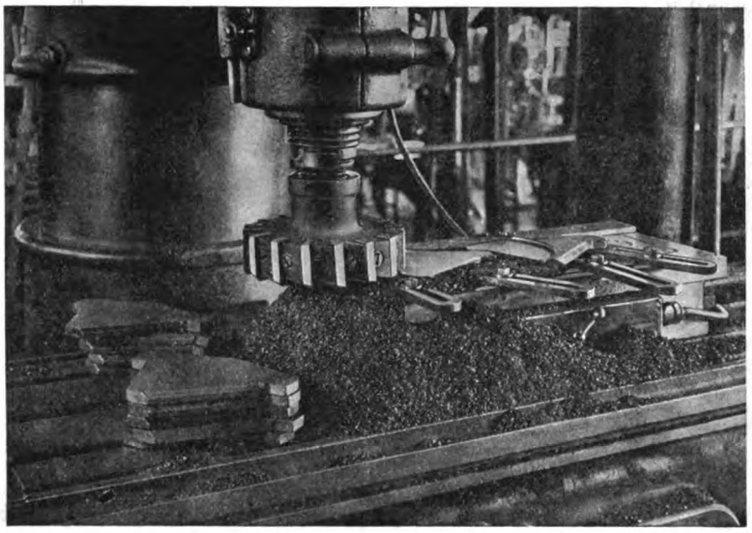


Fig. 4. T-Slot Chuck Used with Milling-Machine

Fig. 3 shows this chuck applied to second-operation work on a Lodge & Shipley lathe. The bracket carrying the brush rigging is shown on the right. Fig. 4 shows a T-slot chuck used for holding cast-iron pieces in a vertical milling machine. Note that the chips are piled just as they fall, the shape of the pile being determined by gravity and not by magnetism. The tool is free from clinging pieces of iron. These two facts indicate the perfect insulation of the magnetic circuit.

The holding-power of the Simmons chucks is demonstrated in Fig. 5, the scale showing that the pull on the inch cube is 150 lb. Another illustration of this point is given by Fig. 6. The chuck here is 31 in. long, 10¼ in. wide, and is used on a 30-in. Gray planer. The work is a piece of cold-rolled steel ¾ by 4 by 31 in. The chip is ⅝ in. deep and $\frac{3}{16}$ in. thick, the table-feed being 40 ft. per minute. It stalled the machine at the point where the cut stopped.

BOWSER OIL-STORAGE TANKS AND PUMPS

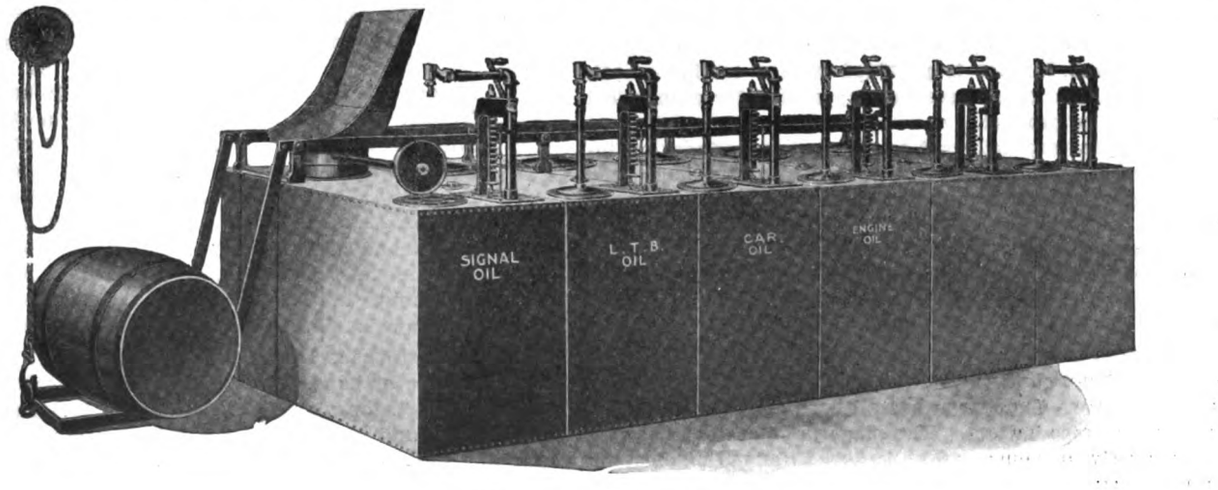
Storage of oils of different kinds is a problem of considerable importance to most industrial plants. Waste of oil through leakage or spilling, damage from spilled oil, and increased fire-hazard are some of the disadvantages of the ordinary methods. The equipment made by the S. F. Bowser & Co., Inc., Fort Wayne, Indiana, has been designed to eliminate these disadvantages. A typical outfit is shown in the accompanying illustration. The barrels or drums when received are hoisted without difficulty by one man so that they can empty into the storage-tanks by gravity. The barrels can be drained completely. The gauge shows the approximate number of gallons in the tank, making it possible to check short barrels. The oil-pump is so constructed as to eliminate leaks from the faucet, also over-run measures, as the pump delivers the exact quantity required. The chance of dirt getting into the oil is also eliminated. The tanks are uniform in height and depth, varying only in width. This makes it possible to place tanks of various capacities in battery, as shown in the illustration. The Bowser equipment conforms to the rules of the Board of Fire Underwriters, as its use materially reduces the fire-hazard.

'FROM THE MINING OF THE ORE TO THE FINISHED PRODUCT'

The completion by the Anaconda Copper Mining Co. in 1918 of a rod and wire-drawing mill at Great Falls, Montana, marks a new departure in the industry in that the company now manufactures the copper that it produces into copper wire, strand, trolley-wire, and rolled-copper rods. The addition of this final step to the long process of mining, concentrating, smelting, and refining, is of great advantage to the users of the products, for the direct supervision from the mining of the ore to the finished product, assures a product of unvarying high quality.

The ore mined at Butte, containing about 3% copper, is first enriched to 8% by concentration. The fine concentrate is then roasted to remove 80% of its sulphur, and is then smelted in reverberatory furnaces; the coarser ore goes to the blast-furnaces. The reverberatory and blast-furnaces produce matte, (40 to 50% copper), and slag as a waste product. The matte is treated in converters which deliver an impure copper. The last stage is reached in the refining furnaces which turn out commercially pure copper, which is cast in the shape of anodes and shipped to Great Falls, Montana, and Perth Amboy, New Jersey. The anodes contain approximately 70 oz. silver and 0.25 oz. gold per ton.

The new electrolytic copper-refinery at Great Falls, which began operation in March 1918, contains 1020 refining tanks, 60 of which are devoted to the production of starting sheets. The tanks are divided into eight sections of 120 each, and are arranged in cascades of five. A separate electrolyte is maintained for each section, and it is pumped by means of air-lifts. The anodes used are of the lug type, 36.5 in. long and 28 in. wide. They are handled by means of a narrow-gauge railway. These cars are moved into the tank-house where the crane transfers 25 anodes at a time



Bowser Oil-Storage Equipment

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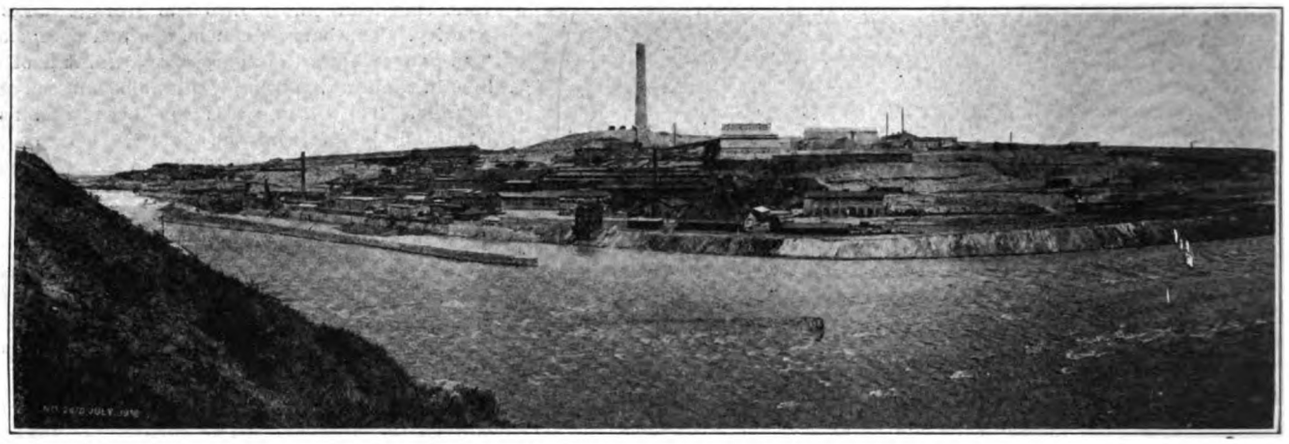

The Anaconda Company's Plant at Great Falls

from the car to the refining tank. Each tank contains 25 anodes and 26 cathodes. The anodes remain in the tank 24 days during which time four drawings of six-day cathodes are made. The finished cathode is 38 by 30.5 in. and weighs 130 lb.; 160 tanks of cathodes are drawn daily and 40 tanks of anodes are changed each day.

The slime contains approximately 12,000 oz. silver and 75 oz. gold per ton. The following is a typical analysis of the electrolyte in the refining tanks.

	Gm. per litre
Free acid	180.0
Copper	43.0
Arsenic	7.0
Antimony	0.5
Chlorine	0.035

The electrolyte has an average specific gravity of 1.235; its purity is maintained by running off daily to the purification plant a sufficient amount of solution to prevent building up. In the purification plant, the solution is concentrated by boiling to 48°B. and run to crystallizing tanks, where about 8% of the copper is recovered as bluestone; the remainder is drawn off and treated in anode-tanks for the removal of the remainder of the copper and the arsenic, antimony, and bismuth. The outlet solution from these tanks is further concentrated by boiling to 56°B. After cooling the iron, nickel, lime, and magnesia are precipitated as basic salts. The bluestone is re-dissolved and returned to the tank-room.

The copper as it comes from the electrolytic refinery is nearly pure but before being shipped to the consumer must be melted and cast into shapes suitable for rolling mills or manufacturers of brass and other alloys. This part of the process is carried out in the furnace refinery. The furnace refinery is equipped with two reverberatory copper-refining furnaces, each with capacity for melting 400,000 lb. of copper day. Each furnace is provided with a casting wheel, mold-presses, and other necessary apparatus for economical handling of the product.

The cathodes are delivered to the furnace-refinery on industrial cars, each car carrying four piles of cathodes, the load weighing about eight tons. When a furnace is to be charged the three large charging doors on the side of the furnace are opened. The charging crane is brought into position in front of the furnace. The long arm on the crane picks a pile of cathodes from the car, thrusts it into the furnace and deposits it. It requires three hours to bring the furnace up to a melting temperature which is from 1100° to 1300°C. About eight hours after the furnace has reached this temperature the charge has all been melted and is free from the furnace-bottom. The slag that has formed, consisting mostly of copper oxide, is now skimmed off, leaving the bath clean.

The refining process is designed to get rid of the absorbed gases in order that physically sound castings may be made. In order to bring this about iron pipes are thrust into the bath of molten metal, through which air is blown. The oxygen of the air unites with the copper, forming cuprous oxide in the presence of which the gas ceases to be soluble in the metal and is expelled. It is rarely necessary to carry the oxidation beyond this point. In this process the impurities contained in the metal are oxidized, and hydrogen, carbon monoxide, and sulphur compounds are driven off.

After oxidation has been completed large wooden poles are thrust into the metal bath and held down beneath the surface of the metal. The dry distillation of the wood tends to reduce the cuprous oxide with which the bath of metal is now saturated. This operation is continued until the oxygen has been reduced to about 0.060%. At this point the polling is discontinued and the slag is skimmed. The bath is now covered with charcoal, and the polling resumed. The polling operation causes agitation of the metal, bringing all of the metal in contact with the charcoal covering the bath. When the copper contains from 0.010 to 0.025% oxygen, it is ready to cast.

The tap hole, launders, and ladles have by this time been made ready for tapping. The wall of refractory material at the tap-hole is cut away, and the metal overflows and passes through a Y-shaped launder into the ladles, of which there are two for each machine. The casting wheel itself is 40 ft. in diameter.

As the molds move around the circle they are sprayed both from above and below to promote cooling and after they have passed half-way round the circle are automatically dumped, allowing the castings to fall into a bosh filled with water. It is this chilling in water that gives the castings or shapes their characteristic red color. The metal when ready for shipment has the following approximate analysis:

	%
Copper	99.96
Oxygen	0.03
Silver	0.0022
Bismuth	0.0004
Sulphur	0.002
Iron	0.0006
Cobalt and nickel	0.0006
Arsenic	0.0017
Antimony	0.0016
Silenium	0.0009

Slag from furnace operation is re-smelted either in the blast-furnaces or converters. The building for the rolling mills is 450 ft. long by 125 ft. wide and is constructed of steel, brick, and glass. The rod mill consists of an 18-in. roughing mill, intermediate mill, finishing mill, bar-heating furnace, coilers, roll-lathe for grooving the rolls, and other

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accessory apparatus necessary to make the mill complete. The wire-drawing machinery, consisting of a 4-block bench for drawing large sizes of wire in coils; a continuous trolley-wire drawing-bench with its reel-stand; one 10-die and one 9-die continuous, double block, wire-drawing machine for drawing No. 12 and smaller sizes of wire, in coils or on reels; two 6-die and one 5-die double block machines for drawing wire from No. 6 to No. 12, and three single-die machines for drawing medium hard wire. The annealing equipment consists of one double chamber non-oxidizing annealing furnace and one open-fire furnace. The stranding equipment consists of four stranding machines of different capacities. All of these machines are served by a 5-ton traveling crane, which covers the full width of the building and runs its entire length.

It is interesting to note that the products of the rolling-mills department are the first of their kind to be manufactured west of the Mississippi. Previous to the erection of this plant, the wire bars from the furnace-refinery were all shipped to mills in the East and Middle West. When wire and strand were required for the power-development projects in the West it had to be shipped back.

LINK-BELT 'LETTGO' MECHANICAL OVERLOAD-RELEASE

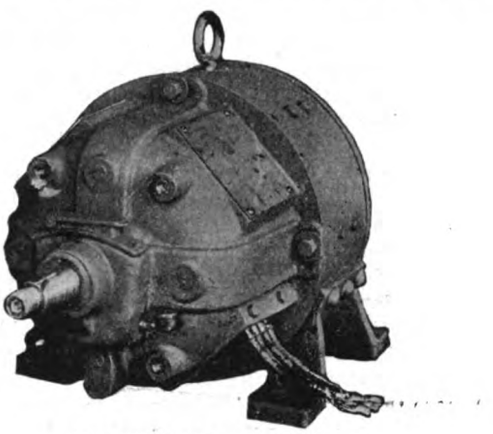
An effective safety-first device that will instantly disengage a drive when the load exceeds a predetermined point, has been developed by the Link-Belt Co. It is known as the 'Lettgo' mechanical overload-release. It is especially adaptable for elevating, conveying, and power-transmission machinery. The 'Lettgo' will automatically disengage the driving from the driven machinery if the load exceeds the fixed amount, thus allowing the driving motor or other source of power to run free and prevent damage, due to the inertia of the motor armature or other high-speed moving parts.

The construction of this device is such that it will release whether the load is gradually or suddenly applied, but it can be set so that it will not trip from jars or shocks. The device is symmetrical, and can be assembled to operate in either direction. It can be adjusted for tension, so that it will operate for any desired overload. The mechanism is entirely enclosed and can be packed with grease for lubrication purposes. Being positive in its action and easily reset, the Link-Belt 'Lettgo' has distinct advantages over other devices designed to accomplish the same result.

DIRECT-CURRENT SERIES-WOUND MOTORS FOR CRANE AND HOIST SERVICE

For severe intermittent varying-speed service where heavy starting torque is required, such as for cranes and hoists, the Westinghouse Electric & Manufacturing Co. has recently brought out the type 'HK' direct-current, series-wound motors. These motors are especially designed for use where the load consists of a series of starts, stops, and reversals, the motors being idle for only short periods of time. These motors are of enclosed construction with small openings in the lower part for ventilation. Covered openings in the top-half of the frame give access to the brushes and the commutator. The most prominent feature of this motor is its compact construction, giving small overall dimensions, light weight, and great mechanical strength. The motor has a forged open-hearth steel frame and solid forged-steel feet. The motors above 3 hp. rating are equipped with commutating poles so that high momentary loads can be carried without series sparking, and long life of commutator and brushes thereby ensured. All field-coils are thoroughly insulated and impregnated. Oil-ring lubrication is used. The brush-holders are clamped to insulated rods mounted on the front bracket, which are dowelled in place. The position of the brushes is thereby fixed for both directions of rotation.

Armature-coils are form-wound and thoroughly insulated and impregnated before being placed in the slots. A blower is placed in the rotor, which effectively ventilates both armature and field windings. This allows a smaller-diameter

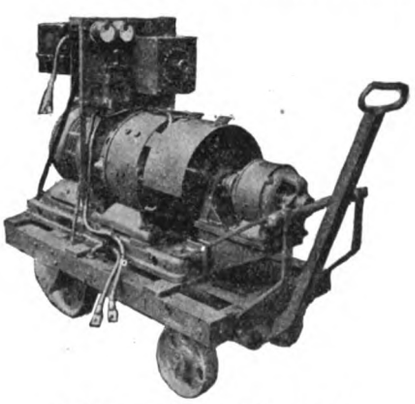


Motor for Cranes and Hoists

armature to be used, producing low flywheel effect. Consequently, little energy is required to start and stop the motor, thereby reducing to a minimum, wear and tear on bearings and brakes. Electrically operated, shoe-type brakes are supplied when ordered. They are bolted to the machined lugs on the motor-bracket, making a compact unit of motor and brake. The brake is simple and rugged and provision is made for adjusting for wear of parts.

SINGLE-OPERATOR ELECTRIC-WELDING OUTFIT

The single-operator electric arc-welding equipment manufactured by the Westinghouse Electric & Manufacturing Co. is exceptionally efficient because the generator operates at arc-voltage and no resistance is used in circuit with the arc. The generator is designed to stabilize the arc, thereby



Welding Outfit Mounted on Truck

eliminating the necessity for providing automatic devices such as relays, solenoid-control resistors, etc., which not only increase the cost of investment and maintenance, but also may not be quick enough in action to follow the instantaneous changes of the arc-circuit. The generator of the set has a rated capacity of 175 amperes, is of Westinghouse standard design and construction, provided with commutating poles and an exceptionally long commutator, which enables it to carry the momentary overload at the instant of striking the arc without special overload protection.

The control is so designed that close adjustment of current may be easily and quickly made, and once made, the amount of current at the weld will remain fixed within close limits until changed by the operator. There are 21 steps provided from 50 to 225 amperes. This gives a current regu-

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lation of less than 9 amperes per step which makes it easier for a welder to do the vertical or overhead work often required in railroad shops and ship construction.

The generator and its exciter are so designed as to make it easy for the operator to strike and to maintain the arc. Although the generator is a short-arc machine, the arc produced is tenacious and causes the deposited metal to penetrate deeply into the work. These features are desirable as they make it easier for a new operator to learn the work and also enable experienced welders to increase their output.

The generator is mounted on a common shaft and bedplate with the motor. Motors can be supplied for either direct or alternating-current circuits. Where an alternating-current motor is used, leads are brought outside the motor-frame for connecting with either 220 or 440-volt circuits. An electrician can change these connections in a few minutes' time. This feature is particularly desirable on portable outfits, which may be moved from one shop to another having a supply circuit of different voltages.

Where the equipment is required for portable service, the motor-generator set with the control-panel is mounted on a fabricated steel truck, equipped with roller-bearing wheels. The portable equipment can be easily hauled about the shop or yards by one man. The suitable plugs and receptacles for three-phase three-wire or two-phase four-wire, alternating-current motors allow the set to be quickly and conveniently connected to the supply-circuit at any desirable point. Only one plug is required for the motor but the number of receptacles required depends upon the number of points at which work is to be done.

SAFETY FIRST IN GLASS

What should we do without glass? We regard it as one of the necessaries of civilized life; yet under certain conditions, it can be almost as dangerous as a sharp knife in the hands of an irresponsible person. Glass is a most useful servant; a utility of greatest convenience when conditions are normal, but when accidents occur causing glass to break and slivers and splinters to fly through the air, human life is endangered. Many a death and many a serious wound has been caused by flying pieces of broken glass. Serious consequences are especially to be feared from the accidental breaking, in collision or otherwise, of automobile windshields, back and side curtain-lights; street-car doors and windows; railroad passenger-car windows; locomotive-cab windows; port-hole and other window-lights on ships; die-cutting, grinding, polishing, loading, and other types of machine guards; office and bank partitions; and revolving doors. Science has come to the rescue with a laminated glass consisting of two sheets of ordinary glass between which is interposed a thin sheet of pyroxylin plastic. Hydraulic pressure and the application of the proper degree of heat welds the glass and pyroxylin sheet together into a solid unit. The pyroxylin binder prevents any scattering of fragments in the event of violent breakage. The transparency of the glass is reduced but 2½ to 3% by the insertion of the plastic sheet. This is so small as to be negligible. If life and accident insurance statistics were consulted to get a record of the vast number of accidents in the aggregate resulting from broken glass, it could readily be shown that the increased first cost of laminated glass to be used in exposed places where experience has proved accidents are most likely to happen, would be more than offset by savings in death and injury insurance payments, loss of wages due to lost time while recovering from wounds, and damage to property. Then too, the suffering and disfigurement caused by cuts should be considered. Laminated glass his its place in the world. As its virtues become known, it will be specified in many industries in which it is now unknown.

Trade Notes

The Baash-Ross Co. is building a machine-shop at Brea, California.

The American Can Co. will construct a $1,000,000 factory-building at Portland.

The Spencer Elevator Co. has moved from 128 Beale street to a new building at 166-180 Seventh street.

The California Barium & Chemical Co. will erect a factory at Long Beach for manufacturing magnesite products.

The National Implement & Vehicle Association has decided to hold a tractor show at Los Angeles in September.

The Fidelity Trust & Savings Bank will erect a $1,000,000 bank and office building on Mariposa street near J, Fresno.

The United States Sheet Metal Co., Boise, Idaho, has completed plans for a new plant to cost approximately $75,000.

The Byron Jackson Iron Works is building a 30 by 100-ft. addition to its pattern-storage department at its West Berkeley plant.

The Southern Pacific Co. has commenced the erection of a new brass-foundry and a new spring-shop at its Sacramento shops.

Eli H. Wiel, president of Buckingham & Hecht, has been elected to the board of directors of the **California Manufacturers Association.**

The Coos Bay Lumber Co. plant at Bay Point, California, which was destroyed by fire on May 27, with a loss of $200,000, is being rebuilt.

The Co-operative Rice Milling Co., of Sacramento, has been incorporated with a capital of $1,000,000 and will erect a rice-mill in that city.

The Samson Tractor Co., a subsidiary of the **General Motors Corporation**, is building a $250,000 warehouse and showroom at Los Angeles.

The Pacific Coast Steel Co. is preparing plans for a two story and basement reinforced concrete office building to be erected at a cost of $100,000.

The Quality Foundry & Manufacturing Co., of Los Angeles, has been organized to manufacture iron and other castings. The capital stock is $20,000.

Plans are being considered by the **Pacific Coast Steel Co.** of Portland, for the erection of a $200,000 plant in that city to prepare powdered coal for fuel users.

The United Railroads will erect a one-story concrete and steel power-house on the south side of Stevenson street east of Second at an estimated cost of $25,000.

The Lodi Dehydrating Co. has been incorporated with a capital of $100,000 by E. A. Horstmann and A. E. Dachesnan of Lodi and C. A. Russell of Sacramento.

The plant of the **Western Potteries Co.**, at Richmond, which was recently destroyed by fire with a loss of $100,000, is to be rebuilt at once with modern equipment.

The Dunning Iron & Electric Co., of Los Angeles, has been organized to manufacture electric specialties and other metal products. Charles W. Dunning is president.

Contract for furnishing the machinery for the bunkers at municipal pier No. 5 at Portland has been awarded to the **Hesse-Martin Iron Works**, of that city, for $56,514.

On account of the shortage of fuel-oil, the **Pacific Mail Steamship Co.** has arranged to convert eight of its oil-burning vessels in the Far Eastern trade to coal-burners.

The Northwestern Brass Foundry has started operations in Portland. F. J. McPherson is president, Robert Gray, vice-president, and W. C. Thom, secretary-treasurer.

The California Paper & Board Mills is installing additional machinery and other improvements at its plant at Antioch, California. The estimated cost is $200,000.

The Clark-Turner Piston Co., of Los Angeles, is making improvements that will permit the doubling of its present output of 1000 light-weight gray-iron pistons per day.

The Ingersoll-Rand Co. and the **A. S. Cameron Steam**

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Pump Works announce a change in their Chicago address. The new offices will be situated at 709 Fisher Building.

The Great Western Smelting & Refining Co., of San Francisco, has purchased the 275-ft. lot at the south-east corner of Spear and Folsom streets, and will improve the property.

The sawmill of the **Georgetown Lumber & Supply Co.** at Georgetown, California, was destroyed by fire on June 14. The loss is estimated at $50,000. The mill will be rebuilt.

B. M. Rastall, who made an industrial survey of San Francisco for the Chamber of Commerce during 1916, has been engaged to take charge of the industrial department of the Chamber.

J. L. Mazzera and **E. La Bat** have taken charge of the repair-shop of the United States Garage at Stockton, and will operate it under the name of the **United States Auto Repair Shops.**

The Western Motor Transportation Co. is erecting a two-story class A reinforced concrete garage and automobile-stage depot at Franklin and Webster streets, Oakland, at a cost of $35,000.

The Northwest Bridge & Iron Co., of Portland, will lay the keel, early in July, for the first of the seven 12,000-ton tank-steamers that it is to build for the Swiftsure Oil Transport Company.

Loews, Inc., will construct a $1,500,000 theatre and office building at Seventh street and Broadway, Los Angeles. Contract for furnishing the steel required has been awarded to the **Llewellyn Iron Works.**

The Pioneer Mill Co., of Honolulu, operating a sugar plantation, has been buying considerable new machinery and is now installing the largest evaporator in the islands, built by the Honolulu Iron Works.

The Consumers' Fuse & Powder Co. is constructing a $100,000 plant at Rocklin, California. The directors are J. D. Meredith, Edward Woerner, Victor Houelcher, William Houelcher, and W. H. Gaffett.

The S. Obermayer Co. has issued catalogue No. 50, containing about 100 pages describing the special equipment and supplies manufactured by the company for brass, bronze, and aluminum foundries.

The 'West Mahwah', the last of the 114 steel steamers built by various yards in Seattle for the Emergency Fleet Corporation, was recently delivered to the Corporation by her builders, **J. F. Duthie & Company.**

The plant of the **California Wine Association** at Winehaven is being remodeled for the manufacture of grape juice. The changes include the installation of a refrigerating plant together with miles of pipe.

The Hughson-Bacon Co. will move about August 1 from its present rather crowded quarters at Third street and Broadway, Oakland, to a new 100 by 150-ft. one-story brick building at Third and Castro streets.

Girard B. Rosenblatt, electrical engineer specializing in the mining and metallurgical field, with the **Westinghouse Electric & Manufacturing Co.**, has moved his office to 521 First National Bank Bdg., San Francisco.

The International Harvester Co. has completed a two-story brick-and-concrete building with a floor-area of 39,000 sq. ft. at Lawrence and Atlantic streets, Los Angeles. It will be used both for offices and as a warehouse.

V. C. Worden, chief engineer for the **Master Carbureter Co.**, of Los Angeles, recently made a trip through the North-West, during which he closed a number of contracts with distributers to handle Master carbureters.

The Ohio Foundry, of Vernon, California, has been incorporated with a capital of $20,000 to manufacture iron and other metal castings. Bernard G. Holz, W. J. Roth, and Morris H. Williams are the incorporators.

The 'Rotarian', named in honor of the Rotary Clubs of America, and the last ship to be built in the North Pacific district for the Emergency Fleet Corporation, was launched on June 17 at the yard of the **Todd Shipbuilding & Drydock Co.** at Tacoma.

The first of the four sections of the drydock purchased from the **Ames Shipbuilding & Drydock Co.** by the Bethlehem Shipbuilding Corporation left the Ames company's Seattle yard on June 26 on its way to San Francisco.

The plant of the **Seattle North Pacific Shipbuilding Co.** on the Duwamish waterway, Seattle, which is owned by **Twohy Bros. Co.**, will probably be converted into a factory for the manufacture of freight-cars and other railroad equipment.

The California Brass Manufacturing Co., of Los Angeles, has been incorporated with a capital of $10,000 to manufacture brass and bronze specialties. The incorporators are Nathan Brostoff, David M. Clayman, and L. R. Raymond.

The Holt Manufacturing Co. has recently purchased a General Electric direct-current electric-welding outfit. This places the Holt welding shop among the best-equipped on the Pacific Coast for both oxy-acetylene and electric welding.

The Rich Steel Products Co., of Battle Creek, Michigan, has bought a three-acre site on Santa Fe avenue, Los Angeles, near the Keystone Iron Works, and will erect a plant for the manufacture of automobile parts and high-grade steel tools.

The James H. Todd Can Cutting Co. has been incorporated in Alameda county to manufacture machinery for the vegetable-oil trade. The company is capitalized at $50,000 and the incorporators are: James H. Todd, Lila B. Todd, and A. J. Woolsey.

The growth of the membership of the **California Manufacturers' Association** has made necessary the establishment of Los Angeles headquarters in the Equitable Savings Bank Bdg., First and Springs streets, in charge of Gordon A. Wey, as district manager.

The $1,000,000 plant of the **Stauffer Chemical Co.** at Stege will be ready for operation about September 1. It will be the largest west of the Rocky Mountains. Sulphuric acid will be produced by the contact process, and the daily output will be 100 tons.

The Northwestern Pacific Railroad Co. will expend nearly $1,000,000 in the immediate future. Equipment to be purchased includes a tug and a car-float, 150 logging flat-cars, stock-cars and steel gondolas, 30 steel and wooden coaches, and three locomotives.

The Pacific Nash Co., of San Francisco, will build on the south-west corner of Van Ness avenue and Washington street. On the second floor there will be a service-station that will be thoroughly equipped with machinery to make it in effect a factory branch.

The Scheau Foundry Co., of Upland, California, which recently acquired the property of the Upland Foundry & Machine Co. has arranged to enlarge its plant to provide for the manufacture of an orchard-heater invented by W. C. Scheau, president of the company.

Contract fur furnishing the entire equipment to be used by **Twohy Bros. Co.** in the construction of $4,000,000 worth of concrete roads in Maricopa county, Arizona, has been awarded to the **Smith-Booth-Usher Co.** The equipment will be 'Lakewood' throughout.

The Los Angeles Union Terminal Co. will construct a seven-story reinforced concrete factory and industrial building costing about $1,000,000, on land adjoining its present group of buildings. Contract for the work has been awarded to the **Wurster Construction Company.**

The Western Lumber Co., of Reno, has bought the timber holdings of the **Powers Timber Co.** in Placer county. A mill with a capacity of 150,000 ft. per day will be built, as well as a railroad extending from a point near Auburn 30 miles up the Middle Fork of the American river.

The interests of E. Scheeline in the firm of **Schnerr & Scheeline**, 799 Golden Gate avenue, has been taken over by Charles W. Gebhardt and A. J. Schuler, and has been incor-

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porated under the name of **J. J. Schnerr Co., Inc.** It will be continued under the management of J. J. Schnerr, assisted by Mr. Gebhardt.

The Lindgren Co., which has the general contract for the construction of the twelve-story class A building to be erected for the **Standard Oil Co.** at Bush and Sansome streets, has awarded the contract for furnishing the reinforcing steel to the **Pacific Coast Steel Company.**

The Navone Manufacturing Co., of Emeryville, which was organized to operate a machine-shop and boiler-works and to reclaim rubber by a secret process, has received permission from the Commissioner of Corporations to sell 15,000 shares of preferred stock to its incorporators at par, $100, for cash.

The Pacific Marine Iron Works, of Portland, has recently completed and installed all the machinery for the steam-schooner 'Ryder Hanify', owned by **J. R. Hanify & Co.** The engines will develop 1000 hp. The schooner will carry 1,400,000 ft. of lumber and will be used in the coastwise lumber trade.

The Carrara Marble Co., of Manhattan, Nevada, has ordered twenty-two sawing machines at a cost of $4000 each. A new semi-Diesel engine of 240 hp. has been purchased and $35,000 has been spent for channeling machinery. This additional equipment will permit shipping two cars of finished product per day.

The Allen Burbank Motor Co. has bought eight acres at Burbank, California, and will commence work immediately on the first unit of its plant, which will have a capacity of 2000 tractors and 2000 trucks per year. The tractor will be specially designed for the small farmer and will sell for a little less than $1000.

The E. M. Smith Co., manufacturers of asbestos yarns, brake-lining cloth, and similar products, have acquired nine acres of land between Los Angeles and Downey, and will construct a $250,000 factory building. It is stated that this will be the only factory devoted exclusively to asbestos products on the Pacific Coast.

The Whiting Foundry Equipment Co., of Harvey, Illinois, has issued catalogue No. 153, which gives a full description of the tumbling-mills and accessories manufactured by the company, together with photographs of plants where the mills are in use. A copy of the catalogue will be mailed by the company free upon request.

The Worthington Pump & Machinery Corporation has issued an interesting announcement of its success in making a new Worthington marine oil-engine of 2400 indicated horse-power. The present engine is of Diesel type, has six cylinders, 29-in. bore, 46-in. stroke, and a speed of 120 r.p.m. Other sizes are planned.

The last of the wooden hulls built for the Emergency Fleet Corporation in the North Pacific district was launched May 28 at the yards of the **Puget Sound Bridge & Dredging Co.** at Seattle. The hull, which was rated at 38% complete, has been purchased by Edward Barrett, of Seattle, and will be remodeled for a freight-barge.

A. Carnegie Ross, British consul-general at San Francisco, announces that the Consulate has received about 140 current catalogues and price-lists from British firms, covering a wide range of commodities. The publications have been classified, indexed, and filed, and are available for consultation at the office of the Consulate.

The Hall-Scott Motor Car Co. recently sold to the **Judson Manufacturing Co.** a 22½-in. gauge industrial locomotive for use in hauling hot metal from the open-hearth furnaces at the Judson company's steel-plant at Emeryville. This engine is operated for three shifts, 24 hours per day, for weeks at a time without any stops for repairs or overhauling.

At a special meeting of the Board of Directors of **SKF Industries, Inc.**, the resignation of B. G. Prytz, as president, was accepted; Mr. Prytz having been elected managing director of the parent company, with headquarters at Gothenburg, Sweden. F. B. Kirkbride, vice-president since the organization of the company, was elected president to succeed Mr. Prytz.

The buildings and equipment of the Wright shipyard at Tacoma, which built several Ferris type wooden vessels during the War, have been sold to the Garrish Supply Co. and Donald McGregor, machinery and supply dealers of Tacoma, who will dismantle the yard immediately. The land upon expiration of the lease will revert to the owner, the Northern Pacific Railroad.

'General Fireproofing', for May, the house organ of the **General Fireproofing Co.**, of Youngstown, Ohio, is devoted to industrial housing. It contains several valuable articles on the importance to an industrial concern of providing proper housing accommodations for its employees and also discusses the advantages of the use of metal lath in such housing projects.

During the discussion of a recent move to call a strike in the shops of Cincinnati, the employees of the **Cincinnati Milling Machine Co.** called a meeting on their own iniative and voted by a large majority to express their confidence in the management of the company by remaining at work. The Cincinnati company is represented on the Pacific Coast by Harron, Rickard & McCone.

The Skagit Steel & Iron Works, Sedro Woolley, Washington, is enlarging its pattern department by the construction of a four-story 50 by 120-ft. building. A two-ton Greene electric furnace is being installed. This furnace in addition to the present equipment, consisting of a one-ton Tropenas converter, will make it possible for the company to furnish castings of any size up to six tons.

The Gandy Belting Co. announces the appointment of Fielder I. Schillinger Jr. to the position of general sales manager, succeediny Chas. H. Dankmeyer, resigned. The recently opened Chicago branch at 549 West Washington St. will be under the charge of H. Milton Michel, who comes from the New York branch. Robert Crane will be in charge of the New York branch at 36 Warren street.

The Clark Equipment Co., of Buchanan, Michigan, has issued a pamphlet containing a reprint of the article appearing in 'Machinery' for February 1920, and describing the various methods used by the company for stimulating co-operation between employer and employee. Perusal of the article shows that the duty of co-operation is recognized to be equally obligatory upon both employer and employee.

The Henneuse Tractor Co., of Sacramento, has been organized to manufacture tractors. The old Liberty Iron Works in North Sacramento has been acquired for a factory. **Meister & Sons**, who have been using the building for their automobile-repairing and body-building plant, have leased a trace of land on the opposite side of the Twelfth Street road and are erecting temporary buildings for their work.

The vessels owned by the **Producers Transportation Co.**, of Sacramento, have been sold to a syndicate of Sacramento men, including E. C. Mitchell, W. E. Hibbitt, and A. T. Gibson. The company owns two steamers and two barges, which have not been operated on regular runs, but wherever freight was obtainable. Additional vessels will be purchased and regular runs established between Sacramento and Stockton and other river points.

Articles of incorporation of the **California Reduction Co.** with a capital of $250,000 have been filed. While the site has not been definitely settled it will probably be at Berkeley. The manufacture of pig-iron will first be undertaken, and the milling and refining of other ores will follow. The directors are: W. H. Firebaugh, F. L. Firebaugh, B. W. Unge, E. Simmons, C. Cain, and Pierce Coombes, all of San Francisco; and W. H. Firebaugh, Jr., of Berkeley.

Contract for furnishing 60 manganese-bronze propellers

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for ships now under construction at Hog Island has been awarded to the **Doran Brass Foundry Co.**, of Seattle. Counting a spare blade for every wheel, this will require 700 tons of manganese-bronze. The company has sublet the contract for casting the iron hubs, which weigh four tons apiece, to the **Olympic Foundry Co.**, and the contract for the machine work to the **Hendricks Manufacturing Co.**, both of Seattle.

The Gorman Metal Co., Inc., with offices and manufacturing plant at 141-145 Clara street, has been organized to manufacture babbitt metal, bearing metals, solder, type-metal alloys, and similar products. The company will also deal in tin, lead, antimony, zinc, copper, aluminum, zinc plates, brazing spelter, and other metals. The officers of the company are E. L. Reese, president; G. Lienau, secretary and treasurer; and D. W. Gorman, vice-president and manager.

Montgomery & Mathi Co., 75 Fermont street, San Francisco, are the sales-representatives of the **Straub Manufacturing Co.** of Oakland and will handle the entire ouput. Offices have been opened at Phoenix, Arizona, and Los Angeles, and additional branches will be established at three other Pacific Coast points. Offices will also be opened immediately in the principal centres of the East. The Straub company manufactures a complete line of acetylene generators, oxy-acetylene torches, and blast torches.

The Davis-Bournonville Co. has issued a catalogue describing its line of acetylene-generators, welding and cutting torches, pressure regulators, portable outfits, and supplies. Particularly noticeable is the portable-cabinet truck described therein, which provides permanent mountings for the pressure regulators inside a steel locker, together with safe storage for torches, tools, and other sundries; also the new non-flashback welding torch, No. 3700; and the new series pressure regulators, made of press-forged bronze.

An interesting side-light on the development of foreign markets by progressive American manufacturers is furnished by a catalogue, issued by the **General Commercial Co., Ltd.**, Yokohama, Japanese agents for the **Wright Manufacturing Co.**, Lisbon, Ohio. The catalogue is printed in Japanese. The Japanese have shown a ready appreciation, not only of being addressed in their native tongue, but in having the scientific principles embodied in the manufacture of hoists, and the quality of the material used, thus directly explained and guaranteed to them.

The buildings, machinery, and equipment of the Skinner & Eddy No. 1 shipyard at Seattle have been sold to the **Barde Industrial Corporation**, of Portland and New York, the same concern that, a few months ago, purchased the surplus equipment and supplies of the Emergency Fleet Corporation. Dismantling the yard will be commenced immediately. The **Skinner & Eddy Corporation** retains the site, but no definite plans have been made regarding its future use. The construction of an ocean terminal is one of the projects that has been proposed.

'Smooth-On Home Repairs' is the title of a valuable booklet just published by the **Smooth-On Manufacturing Co.** In this book has been explained just how to repair leaks in boilers, stove-pipes, radiators, furnaces, tanks, and the many other household fixtures that need attention from time to time. There are from 30 to 40 different kinds of repairs with the remedy illustrated and explained. The use of Smooth-On in automobile repairs receives attention also in this book. Cracked water-jackets, leaky radiators, and scored cylinders are all taken up and their repairs explained.

The first four bulletins on 'The Care and Operation of Modern Foundry Equipment', issued by the **Foundry Equipment Manufacturers' Association**, announcement of which was made in 'Metal Trades' for March, have been received. The bulletins are in loose-leaf form and a stiff-cardboard binder, 5 by 7 in., is furnished for holding the entire series. The bulletins are clearly and entertainingly written, and contain much useful information. The titles of the first four are as follows: 'Your Body is a Machine'; 'The Foundry is a Poor Engine-Room'; 'Sand as a Lubricant'; and 'Foundry v. Machine-Shop'.

A new 10-ton open-hearth furnace designed by the **McLain-Carter Furnace Co.**, of Milwaukee, was recently placed in operation at the plant of the **Black Steel & Wire Co.**, of Kansas City, Missouri. While rated at 10 tons, the maximum capacity of the furnace is 30,000 lb. and it is guaranteed to melt 5 heats per 24 hours. The furnace will be used in the production of wire. The 4-in. ingots cast from the furnace will be rolled into wire-rods with only one heating. The **Aetna Steel Castings Co.**, of Lorain, Ohio, which has been operating a 5-ton McLain-Carter furnace, has recently placed an order for a second furnace of the same type.

The Wellman-Seaver-Morgan Co. has recently issued several bulletins as follows: No. 41, 'Coal and Ore Handling Machinery; No. 42, Special Cranes; No. 43, Hydraulic Turbines; No. 44, Hoisting and Mining Machinery; No. 45, Steel Works Equipment; No. 46, Coke-Oven Machinery; No. 47, Port and Terminal Equipment; No. 48, Rubber Machinery. The bulletins contain in all about 200 pages of descriptive matter. An interesting feature of the bulletins is the practice of placing a photograph of the apparatus on the left-hand page and a blueprint working-drawing on the right-hand page. Together with a few lines of text, this arrangement gives a clear idea of the equipment described.

The Hall-Scott Motor Car Co. reports that the demand for its marine and aviation engines has become so great that it has decided to concentrate on these two lines, discontinuing temporarily its other lines, including industrial locomotives, self-propelled railroad motor-cars, and other railroad equipment. Motor-boats equipped with the company's marine engines won all first and second places at the recent races at Miami, Florida, establishing new world's records. The boat winning first place is the same one that carried off the honors at the Detroit races last August. These are 30-ft. boats and they make 40 miles per hour and up. The Peruvian government purchased both the first and second place winners.

The Hall-Scott Motor Car Co. recently sold to Henry Ford, for use on his country place at Dearborn, Michigan, a six-cylinder, 150-hp., marine-type stationary engine of the same general type as that used in the comanpy's self-propelled motor car. It will be used to operate band and circular saws. The engine will operate on low-grade distillates. The carbureter is equipped with a Delco auxiliary starting-device, together with a small motor direct-connected to a 3-in. fan, which blows the flame against the intake-manifold and in this way secures the advantages of hot-bulb ignition. There is also an auxiliary valve in each cylinder for compressed air supplied by a compressor direct-connected to the crank-shaft. The engine has an electric starter, and is equipped with double Delco ignition, with two spark-plugs in each cylinder. The engine weighs six tons and cost $15,000.

The Wheeler Condenser & Engineering Co. announces the publication of the 1920 edition of its popular booklet 'Steam Tables for Condenser Work'. This is the fifth edition. Every engineer who deals with the condensation or evaporation of steam should have one of these handy tables. The pressures below atmosphere have been especially calculated for this book. It gives the properties of saturated steam from 29.8 in. vacuum to atmospheric pressure in increments of tenths of an inch. The vacuum in inches of mercury is referred to a 30-in. barometer. This method is of course superior to the old method of giving absolute pressure in pounds per square inch, since it is customary to read vacuum in inches of mercury. A complete table is also given of the properties of saturated steam above atmospheric pressure. The book tells how to make

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measurements by means of the mercury column and barometer. It gives constants and tables for making corrections. It is a handy book and of such size that it can be carried around in the vest pocket.

The Western Aluminum Manufacturing Co. has completed its aluminum foundry at its new plant at Emeryville in the new industrial district on the site of the old race-track. The first heat was poured early in June. The foundry is a 30 by 90-ft. corrugated-iron and wood-frame building equipped with a Johnson furnace having a capacity of 150 lb. and a tilting-furnace having a capacity of 200 lb. The plant is equipped to turn out 800 lb. of castings per shift. A general jobbing business in aluminum castings is being done. The main building, containing the offices and the shops for the manufacture of the company's complete line of 'Everlasting' cooking utensils, has been completed. This is a concrete and heavy-mill construction building, 100 by 165 ft. Work of installing the machinery is now under way. The company will be equipped to make its own spinning-dies and other special equipment, and will sell its product directly to the trade. The officers of the company are R. R. Beggs, president; H. B. Knowles, general manager; and J. S. McKay, secretary and treasurer, in charge of the sales department. The total cost of the plant and equipment will be about $150,000.

About 40 members of the **San Francisco Section** of the **American Society of Civil Engineers** recently made an inspection trip to the Hetch Hetchy valley under the able guidance of M. M. O'Shaughnessy, city engineer of San Francisco, assisted by N. A. Eckart, J. M. Owens, and L. T. McAfee, of the city engineering department. The party left San Francisco on the morning of Saturday June 12, spending that night at Groveland, stopping on the way at the lower portal of the main 18-mile aqueduct tunnel. Sunday was spent in a trip up the line to the damsite in the valley, stopping at the Big Creek shaft, South Fork portal, Early Intake portal and power-house, and the Mather sawmill. Part of Monday morning was devoted to an inspection of the work at the damsite, and the remainder of the day was spent in a trip to Lake Eleanor. Several of the party went on to the Yosemite valley on Tuesday, the rest of the party returning to San Francisco. Among those directly or indirectly connected with the metal trades, who made the trip, were W. H. Popert, U. S. Steel Products Co.; W. B. Gester, Robert W. Hunt & Co.; W. H. Kirkbride, chief engineer maintenance of way, Southern Pacific Co.; E. H. Barkmann, Missouri Valley Bridge & Iron Co.; Edward Noble, Pacific Rolling Mills Co.; and A. T. Parsons, 'Metal Trades'.

The Westinghouse Electric & Manufacturing Co. has been awarded the contract to supply the propelling machinery for the two new freighters being built for the Matson Navigation Co. at the yards of the Moore Shipbuilding Co. These vessels will be 497 ft. long overall, with a molded beam of 62 ft., and a deadweight capacity of 14,000 tons at a draft of 30 ft. They are specially designed for the rapid and economical handling of cargoes, the machinery being placed aft and the holds arranged with minimum obstructions and a maximum of hatches and ports. The propelling equipment of each ship will consist of a 5000-hp. Westinghouse turbine, consisting of a high-pressure and a low-pressure element, which will drive the propeller through a common floating-frame gear. This gear is to be of the double-reduction type, reducing the turbine speed of 3500 r.p.m. to 95 r.p.m., a ratio of 37 to 1. The speed of the ship will be 12½ knots. Each turbine element can be operated separately, if the other is out of commission, and both contain astern elements giving 40% of ahead power. Additional nozzles are provided on each turbine to permit of an increase of 20% of the turbine's power in case either steam pressure or vacuum (or both) should fall below normal. The boilers will be oil-fired and will carry a steam-pressure of 225 lb. The superheat will be 50°, and the vacuum 28½ in. In addition to the turbines and gears for these vessels, the Westinghouse company will also furnish the air-ejectors, air-separators, and other auxiliaries. The condensers in each ship will have a condensing area of 10,500 square feet.

Obituary

N. A. Christoff, vice-president of J. F. Duthie & Co., died on June 16 at his home at Seattle.

Edward Double, president of the Union Tool Co., and inventor of the Double underreamer and a number of other oil-well tools, died on May 28, at Pittsburgh, Pennsylvania. Mr. Double grew up with the oil business. He was born at Titusville, Pennsylvania, October 15, 1871. In 1898 he came to Santa Paula, California, and worked in the oilfields in that district for some time. Later, he engaged in the manufacture of oil-well tools. In 1903 he moved his business to Los Angeles. When the Union Tool Co. was organized, Mr. Double became president and general manager, which position he held until his death. In later years, while retaining his residence at Los Angeles, he divided his time between the company's plants at Torrance, California; West Chicago, Illinois; and Carnegie, Pennsylvania.

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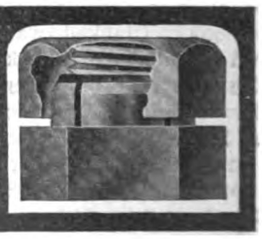

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